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THE EASTWOOD MULTIPLE-ARCHED DAM.
BY JOHN S. EASTWOOD.

EXPERIMENTS WITH SUSTAINED HIGH FREQUENCY HIGH VOLTAGE.
BY J. C. CLARK.

HYDROELECTRIC COST DATA.
BY J. D. ROSS.

THE DIESEL ENGINE.

THE TELEPHONE PROBLEM.
BY D. P. FULLERTON.

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Alphabetical Index to Advertisers, Page 8 Where to Buy It in the West, Page 9

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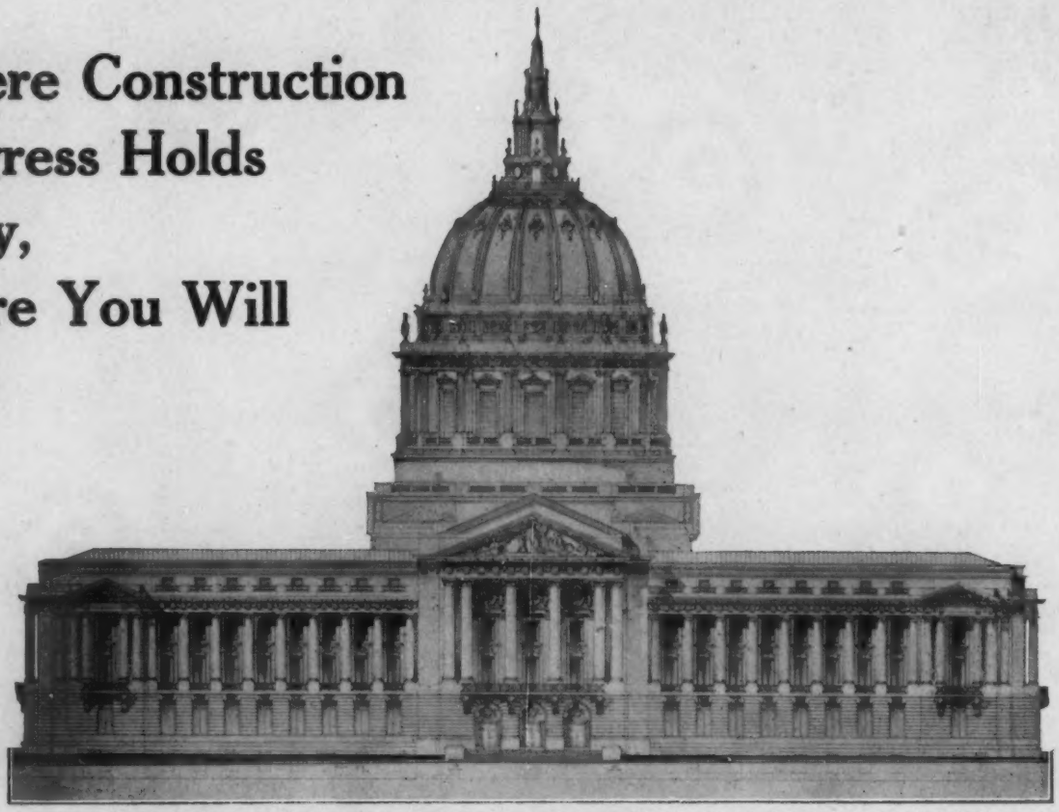

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THE EASTWOOD MULTIPLE-ARCHED DAM

BY JOHN S. EASTWOOD.

(This paper constitutes a critical discussion of the several features of efficient dam design, particular stress being laid on the fact that each dam site requires a design especially adapted to it.—The Editor.)

Downstream View of Eastwood Multiple Arch Dam.

The perfection of the design of dams that shall be the last word on the subject can only result from long study, intimate analysis, and practical experience in their erection.

The only genius is a large capacity for hard work. Any approach to the evolution of a perfect piece of apparatus for a given function depends on an intimate knowledge of every feature of the problem under consideration. The analytical chemist uses many fine sieves and uses many tests to determine the final resultant components of a substance. Likewise, the engineer who would design a nearly perfect work must first analyze for basic principles and then construct a synthetic structure based on the results of the analysis.

It is only in this way that the goal of complete perfection is reached.

Usually we do not appreciate the intricacies of a problem until we start to solve it. We then unfold, one at a time, the basic factors of the problem and must give them their true weight in the final result. In the design of multiple-arched dams, there are a great number of these basic factors to consider, and they are so inter-related that not only must their influence be considered, but each must also be considered in connection with its relation to the other basic factors.

The fundamental problem of dam design is to provide a barrage for water, or other liquid, at a minimum of cost and a maximum of safety and permanence, in other words of the highest efficiency.

The result can only be attained by the application to each particular problem of the basic principles of each feature in the design and its true value

and weight in the problem.

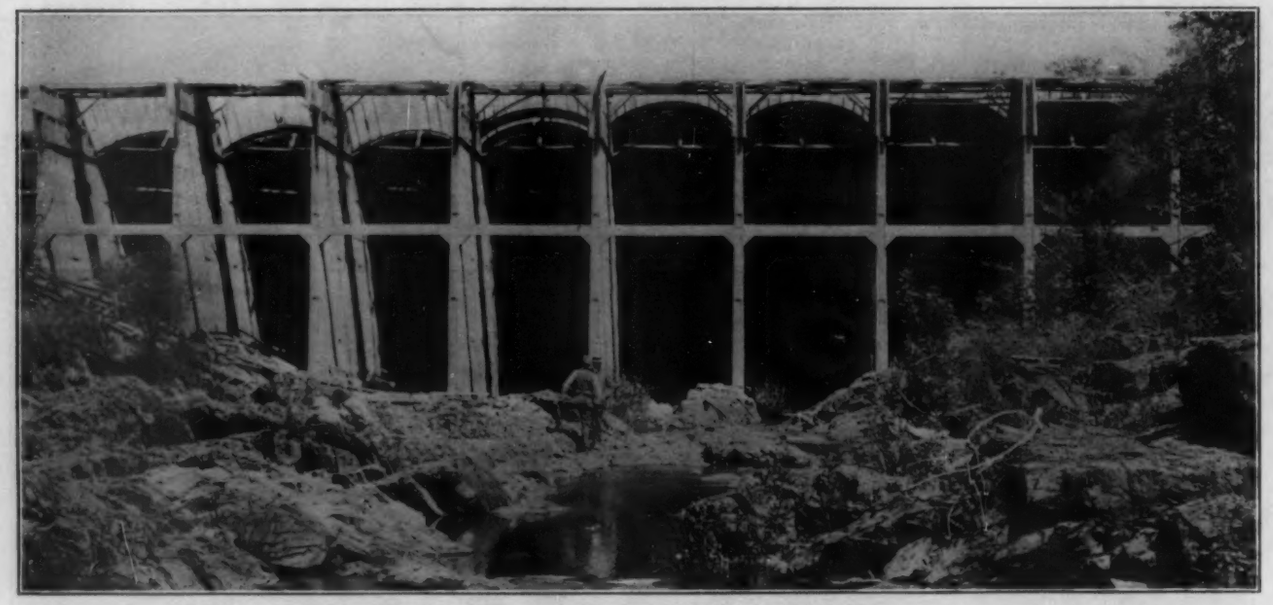
The novice will find himself using assumptions, taking for granted certain rules, which on more complete analysis he will find lead to far different results than was expected and assumed.

The song runs, "Every little movement has a meaning all its own," and this is epecially true in the design of multiple-arched dams where the movement of one feature may put some other vital feature beyond the edge of safety limits.

The dams that go out are the dams designed by novices, because in the nature of things it is impossible for the novice to foresee results.

All over the world large sums of money are being sunk in the erection of inefficient dams, and in no other kind of structure is there such economic waste as in dams.

One reason for this is that the rarity of the use of this kind of structure leaves most engineers novices through lack of practice and experience in their



Upstream View of Eastwood Multiple Arch Dam.

The theoretical is always the framework, and on it must be placed the body of the practical structure

The matters of the economic slopes, spans, angles of arc and other features are all determinable, but they are also all inter-related and interdependent, and for that reason each dam site requires a design especially adapted to it. Any one of these dimensions can be varied through a definite range and still maintain the structure within the limits of safety, but it will not meet the important condition of best efficiency, unless each sustains its proper relation to all of the others.

To reach maximum efficiency, it is necessary for the designer to select the proper dimension for each of the above elements of design for the particular site under consideration.

The trend of thought of the novice in design is to copy dimensions from existing works and apply them to the problem in hand, assuming that they should be right or they would not have been used in the design. The reason for their use in the original design is overlooked.

Another feature one sees is the crudity of design, and the all too apparent overlooking of the essentials to maximum efficiency.

Dams of all types are being designed by novices purely by guess and by the rule of thumb.

The more efficient a piece of apparatus is, the more complex the design, even though the resultant structure may be simple in itself, and simplicity itself to the expert designer.

design and construction. The only safe course for the novice is to hold to the traditions of design and to copy works that are standing, for the subject is too large to be consummated in the time he has to give it. Like a babe learning to walk, hesitatingly holding fast to a chair, before he starts to his mother's arms, the novice in design feels safe from falling as long as he clings to tradition for support.

The perfect solution of the problem will be most nearly approached when a design is provided that will give as nearly equal strength in all parts as the conditions of service to be performed will permit.

This is the general rule for multiple-arched dam design.

We cannot reach the resultant of highest efficiency unless we can integrate the values of each factor or the design in itself and also in its relation to all of the other factors.

It is assumed that the only material available adapted to the design is Portland cement concrete.

The controlling factor is stress, or the work the structure is to perform. The forces acting to set up stresses are the water pressure, the weight of the materials of the structure, and the changes in the volume of the materials due to temperature change above or below temperature of erection and the moisture content variation. Having selected a proportion for the concrete such as will give the most economic result, the permissible loading will then be determinable and a safety factor chosen, based on the ultimate strength of the concrete.

This is the initial factor, for upon it depend all dimensions of the design.

The safe load on plain concrete of the best quality, in compression, (and no other than best quality should be permitted or considered), is given by the best authorities at from 400 to 600 lb. per sq. in. This is usually based on an ultimate crushing strength of 3000 lb. per sq. in., and will consequently give safety factors of 7.5 against crushing. The safety factors used by the author are 10 and over.

Having determined the loading and safety factor in the concrete, the next step is the design of the structure itself.

It must be remembered that there is an economic point for the slopes, of the water face and back edges of the buttresses, of span and of arc, all of which are dependent on the allowable loading.

Consider first the slopes of the up-stream and down-stream faces. These must be such as to place the resultant of the loading over the center of the base area of the buttress foundations, for all but the top sections. This gives absolute stability. The slopes will depend on the ratio of the weight of masonry and the superimposed water loading. As the water loading is in a constant ratio from 0 at the surface and increasing regularly with depth, the weight complement of the water load will depend on the slope of the water face.

The flatter the slope of the water face, the greater the water load complement, and the less the required masonry load for stability.

The flatter the water face the steeper the water load resultant, which also affects the masonry load complement required.

As the buttress slopes front and back may vary through quite a range without great alterations of quantity, though there is an economic point, the water face slope is really more influenced by the allowable loading in the masonry and this by the span and angle of arc used.

Having the unit loading, the span must be determined as well as the angle of arc of the arch dam before the economical slope is determinable.

The span is influenced by a number of conditions, only a few of which are independent of the conditions at the site under consideration.

Among the influences affecting the economic span are, in the order of their importance:

1. **The configuration of the site.**
2. **The allowable loading.**
3. **The height of structure.**
4. **The depth of excavation.**
5. **The unwatering difficulties.**
6. **The cost of form materials.**
7. **The availability of rock for pudding stones.**
8. **The cost of transportation.**
9. **The combination of or omission of any of above.**

The required amount of buttress area is the same for all spans for equal loading below the point of full loading, but the heads of the buttresses must have a mechanical thickness so that there will be more material used with shorter spans.

Shorter spans also call for more forms, more pits, a smaller percentage of pudding stones, and possibly unwatering difficulties, but at the same time the arched face will increase directly with the increase of the span.

Thus it is seen that the true economic span is determined by a summation of the positive and the negative influences at each site and these must be determined in their true economic value by sound engineering judgment in each case. Therefore there can be no stock economic span.

As the quantities in the arch rings in any case increase directly with the spans, when using the economic angle of the arc, the weight of the structure and the resultant slopes depend on the span. For balanced stability they will be steeper for a heavier structure.

A heavy structure is a result of a light loading or an uneconomical span.

For the economic design, the quantities will vary with the initial loading allowed.

The quantities and consequent cost depart rapidly from the economic point, due to faulty design.

There is also danger in the unbalancing of the design of setting up stresses in excess of good practice, along with the lack of economy.

As to the water face arches, it must be remembered that this feature is the most vital part of the structure, for it is the real dam or water stop, while the buttresses merely support it.

In the arch we transmit and distribute the load to the buttresses, to be taken by them as loaded columns to the foundations.

There is an economic arc of quantity and another for quantity plus stress. Which one we use depends on the depth of the water resisted.

The arched deck must carry its load and do so with the least stress for a given quantity of material in it. The arched deck must also be impervious. To be impervious it must either be dense or be provided with a water-tight skin, supported by the wall.

Thinness does not mean either weakness or perviousness. Thickness does not mean imperviousness or strength, so it is not a question of thickness of wall for imperviousness or for strength, but of one of sufficient thickness for the ecomonic handling of the load, and the making of this wall water-tight.

The arch ring thickness should taper evenly, and should not be stepped, both because the re-entrant angles are lines of weakness, and because they are more expensive to build.

The thickness is not determined as at a fixed relation to the height, but the actual stresses set up by the water load, due to depth below the possible surface.

The initial stresses are computed by the well-known ring formula, $T = pr$, in which T is the tangential thrust, p the pressure due to depth per unit of area, and r the radius of the extrados of the arch ring.

The initial pressures are normal to the surface, and are therefore radial and set up in the arch ring tangential stresses.

The assumption is made that the line of pressure is at the middle of the arch ring. This is true only of the infinitely thin ring.

It lies inside of the middle line of the ring, a fact to be borne in mind in considering the stresses in a thick arch with small arc and high initial loading, as the stresses set up by rib shortening, due to the water load and temperature change, are very much increased by the shortening and thickening of the arch ring.

The subject of arch stresses is too large and

covers too much ground to be more than touched upon in this article.

Suffice it to say that the reinforcement of arches with steel is in the nature of an insurance against the localization of cracks, and for this it must be proportioned as a percentage of the area, and when the arch rings are very thick the quantity of steel increases and its efficiency decreases proportionately.

The reinforcement in an arch of very thick section to be effective must vary in proportion to its lack of efficiency, hence the percentage must increase more rapidly than does the thickness to remain equally efficient.

The arc of the arch must be considered in its relation to quantity for stress, and this leads to the economic arc. The economic arc, quantity for stress, is the equal or more than the economic arc for quantity.

The volume change stresses in the arch may be set up by one or a combination of all of three different agents, namely, the water load, which combines with the normal component of the weight load, which is constant and varies with the thickness; the temperature changes, which may be plus or minus in their relation to the water load, but will always be minus in practice and act with the water load; the moisture content changes, which may be plus or minus to the others, to say nothing of Poissons ratio, which is a component depending on the slope, is constant, and tends to resist the water load.

The temperature drop is always more in a thick than in a thin wall, for the reason that the rise of temperature is greater in the setting process and the fall is to that of the water normal temperature.

The total range of change of temperature is greater from the mean temperature with a thin wall, but the total change from temperature of erection to mean water temperature is less.

As the temperature drop acts with the water, and a rise of temperature can only take place when the reservoir is empty, the drop is the critical point, and is maximum in a thick wall.

The strength as well as the efficiency of the arch lies in its comparative thinness.

Knowing all of the stresses, their value and directions, the safety factors can be determined absolutely. The safety factors are the things of most importance, and can only be determined by complete analysis of the individual project.

The maximum efficiency can only be obtained by making the safety factors of all the elements as nearly equal as possible, when the result will be the cheapest and strongest structure possible.

The structure must have either a solid foundation or a tight cut-off wall.

There can be no uplift thrust possible.

All types of dams are equal in cost at zero height, departing from each other with increase in height.

The Eastwood multiple-arched dam leaves all competitors in economy and is adapted to a wider range of height than any other type. There are very few sites where any dam is safe that an Eastwood multiple-arched dam cannot be made safer. There are few places where it is possible to build any other type as strong and as cheaply. This dam can be built with high safety factors more cheaply than even an earth dam.

ELECTRIC FLOATS AT PORTLAND.

A parade of electric floats emblematic of the history and progress of Oregon was the feature of this year's Rose Festival and also of the electrical parade on the night of the Fourth of July under the auspices of the Portland Ad Club. Because of their electrical interest the accompanying pictures were taken especially for this journal through the courtesy of the Portland Railway, Light & Power Company.

The cars were historically arranged showing the early Indian life, the discovery of the Columbia River, the Hudson Bay traders, and the coming of Lewis and Clark. Life on the plains, harvest time, and blazing the trail of steel are more recent, while contemporary progress is depicted by the electric power plant, "the gift of many waters," the royal salmon, the giant fir, the beautiful apple blossoms and the fragrant roses. These, together with the new commerce attendant upon the Panama Canal, pictorially presented the story of the building of this great empire.

The floats were the product of six months' hard work by twenty men, representing a cost of $25,000. The flat cars were donated by the Portland Railway, Light & Power Company. In addition, there were six band cars, of which three were carried on electric locomotives furnished by the Pacific Bridge Company.

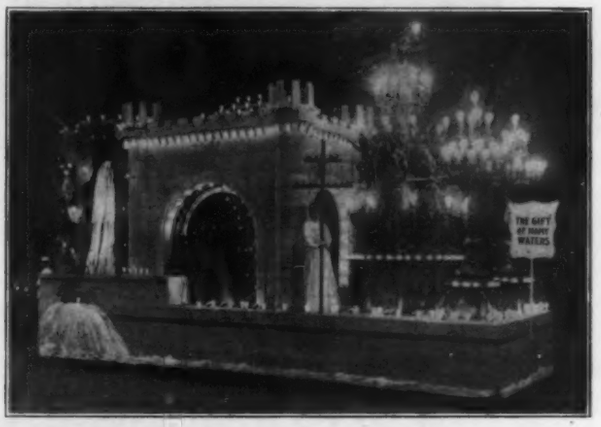
The cars were propelled at slow speed by their own motors and many mechanical features on the floats were motor-operated. All of the 20,000 incandescent lamps were special series lamps rated at 120 volts and using trolley current. It is estimated that the power to operate the floats cost $500 per night.

The Portland Ad Club showed a striking float of optimism, prosperity and confidence burning the "psychological boo-ga-boo."

CASH INVESTMENT OF THE RAILWAYS DURING SIX YEARS.

During the six fiscal years 1908 to 1913, inclusive, the steam railways of the United States of Class I invested in their road and equipment cash to the amount of $4,010,385,303. Railways of Class I, so designated by the Interstate Commerce Commission, are those with annual operating revenues of over $1,000,000. They include about 90 per cent of the mileage, receive more than 96 per cent of the revenues, and handle more than 98 per cent of the traffic.

This cash investment of the operating railways of Class I of the Eastern District during the six years was greater than the amount of capital securities issued by them during this period, and was 19.9 per cent of the aggregate of their capital securities outstanding June 30, 1913; of the railways of the same class of the Southern District it was 21.1 per cent, and of the railways of the same class of the Western District it was 23.2 per cent of the aggregate of their capital securities outstanding June 30, 1913. That is, the cash actually expended by these railways during the last six years upon their properties used in transportation amounts to more than one-fifth of their total capitalization at the close of the last fiscal year. This is at the rate of $668,397,551 per year.



Electrical Floats at Portland.

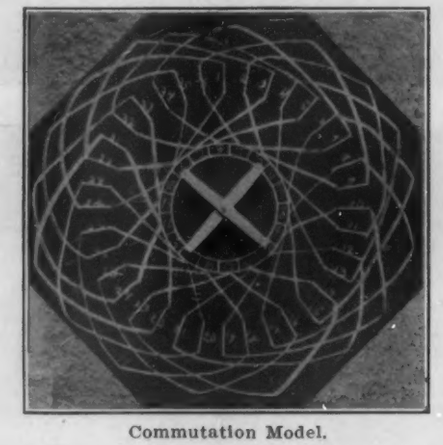
ELECTRICAL DEMONSTRATIONS.

BY E. L. ARNOLD AND D. B. MUNROE.

(These demonstrations for class room work were presented as a thesis to the University of Southern California for the degree of Bachelor of Science in Electrical Engineering, and delivered as a paper at the last meeting of the Los Angeles Section, A. I. E. E., by the authors.—The Editor.)

Proposition IV—Commutation Model.

The object of this proposition was to illustrate the theory of commutation. This was accomplished by means of a black wooden disk on one side of which was drawn the conventional diagram of a thirty-six



Commutation Model.

inductor drum wound armature and an eighteen segment commutator while on the reverse side was the Gramme ring winding with an eighteen segment commutator.

As this was painted on black board any desired armature winding could be placed on the drum armature and its currents checked out and the feasibility

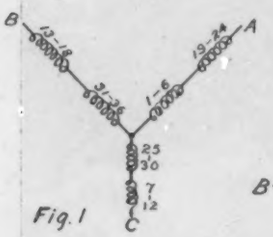


Fig. 1

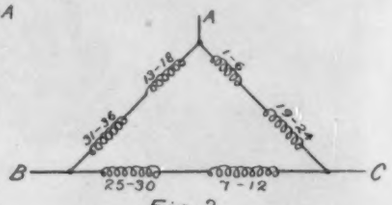


Fig. 3

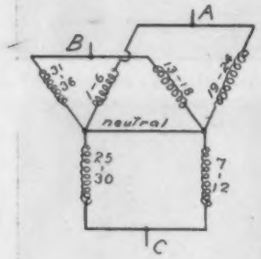


Fig. 2.

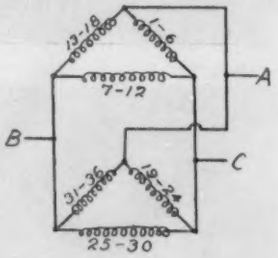


Fig. 4.

Fig. 1. Series Y.
Fig. 2. Parallel Y.
Fig. 3. Series Delta.
Fig. 4. Parallel Delta.

of the winding determined. By means of rocker arms at 90 degrees apart the brushes were represented and were brought to bear on the commutator segments. By moving the arms the brushes can be made to bear on different commutator bars and then the difficulties arising thereby could readily be seen and the effects of shifting brushes either way was determined.

The various windings suggested in Proposition I can be used to good advantage and the advantages of one over the other readily seen and currents traced through and showing the functions of the brushes on a generator.

Also by this blackboard method the connections necessary for an alternating current winding can be worked out and discussed, and after they have been traced through the results can be applied to a motor in the laboratory which also has 36 inductors whose ends have been brought out to a terminal board and so arranged that any desired combination of inductors could be obtained.

The following four windings were figured out using a three-phase circuit on the model and then tested on the above mentioned motor.

It was evident that this motor was designed to apply full voltage across each coil of six inductors, which necessitated the use of the two parallel windings, for the series combination in which half voltage was applied gave poor starting torque and load conditions below the parallel connections.

The accompanying diagrams indicate the combinations of coil used in the four windings.

MEXICAN TURBINE-RUNNER CANNON.

Advices have just been received by the Pelton Water Wheel Company that some large phosphor bronze Pelton-Francis turbine runners operating in a Mexican hydroelectric plant were put to rather a novel use by the rebels. In a raid by one of General Obregon's columns the power plant was partially demolished and the turbines wrecked. The raiders took the bronze runners and reduced them to small fragments, after which they were melted and used in casting two small muzzle-loading cannon, which were subsequently effectively used by the Constitutionalists in their operations around San Blas, Tepec and other points.

The cannon were each mounted in a gun-carriage consisting of a pair of old ox-cart wheels, the whole outfit being arranged for ready dismounting and sectionalization for muleback transportation. At the initial trials the gunner (a former power-house operator) recalling evidently that the turbines carried a considerable overload during the peaks, worked on the theory that the cannon would also stand an overload of powder, with the result that the gun-carriage was wrecked and a pack train stampeded amid general cries of "Caramba!" Possibly the "high specific speed" characteristics of these turbine runners may partially account for their lively actions in their new sphere of usefulness.

The magnetic quality of iron melted in vacuo is superior to iron melted in air, because it loses from 50 to 90 per cent of its original carbon content. In experiments at the University of Illinois a permeability of 19,000 at a flux density of 9,500 gausses was recently obtained with electrolytic iron melted in vacuo. The average hysteresis loss is less than half of that found in the best grades of commercial transformer iron. Its low specific electrical resistance of 9.96 microhms can be remedied by the addition of silicon or aluminum, whose alloys increase the resistance without materially affecting the magnetic quality.

HYDROELECTRIC COST DATA.

BY J. D. ROSS.

The following table of costs has been compiled from the records of the Seattle Lighting Department and aims to show in detail the cost of Seattle's municipal plant as it appeared on the books at the end of 1912. The first part of the table gives the total costs of each of the main sub-divisions of the plant and the cost per kilowatt of generator capacity. This capacity is taken as the maximum rating of all the generators on a 40 degree C. temperature rise. The table is not intended to show the cost of the average hydroelectric plant, and it would not represent exactly the cost of reproducing the present plant. The fact that the plant was started on a small scale and extended to meet the need as funds were available makes considerable difference in the expense of its construction. The total of $62 per horsepower for the generating system is, however, a very reasonable figure for such a system in this part of the country.

To get unit costs, each item of the plant is assigned a capacity in kilowatts. To simplify comparison, the capacity of the dam, penstock and generating units are given in terms of output at the generator. For instance, the smaller penstock will supply water to generate 3600 kilowatts at the switchboard, and it is estimated that the dam will give sufficient storage to care for a generating station of 9000 kilowatts capacity, having the same character of loading as the present system, in any season. The transmission lines are rated on a basis of 10 per cent power loss with 90 per cent power factor at the substation. The substations are rated according to their transformer capacity at normal load, while various pieces of apparatus in the station are given a normal rating. The distributing lines are rated on a basis of actual capacity with good regulation. Installations are rated according to connected load. In the cluster lighting system the cost of the various items is computed on a basis of costs per pole.

The tables of unit costs for wires in place, poles, services and installations are compiled from the records of the actual cost of doing this work by the department. In all cases where overhead charges are not included in the unit costs, 10 per cent should be added to cover these charges.

General Costs.

Division of Plant.	Cost.	Cost per kw. on basis of 15,500 kw. Capacity
Wood Crib Dam	$ 61,863.80	$ 3.99
Penstocks	299,471.59	19.32
Power Station	354,387.44	22.86
Transmission Lines	232,629.62	15.01
City substations	242,096.21	15.62
Lake Union Auxiliary Station	95,550.32	6.16
Total Generating System	$1,285,998.98	$ 82.96
Commercial Distributing Circuits, with poles	$ 966,906.87	$ 62.38
Installations, Meters, Service, Lamps, Motors, etc.	616,416.25	39.77
Series Street Lighting System	358,049.33	23.10
Cluster Street Lighting System	398,165.94	25.69
Underground Distributing System	125,797.73	8.12
Storeroom	774.44	.05
Total of Distributing System	$2,466,110.56	$159.11
Total cost of plant, exclusive of new masonry dam, now under construction	$3,752,109.54	$242.07
Cost per h.p. at generators, on a basis of 20,800 h.p. capacity:		
Generating System		$ 61.83
Distributing System		118.56
Total System		$180.39

Detail Costs.

Division of Plant.	Capacity kw.	Cost.	Unit Cost (per kw.)
Wood Crib Dam	9,000	$ 61,863.80	$ 6.87
Penstocks, combined	11,000	299,471.59	27.23
No. 1 Penstock, complete	3,600	84,475.79	23.40
15,407 ft. 49 in. wood stave pipe, complete in place		33,044.16	
1,061 ft. 48 in. steel pipe, 308,000 lbs., complete		14,386.01	
16,468 lineal ft. grading and filling		37,045.62	
No. 2 Penstock, complete	7,400	214,995.80	29.00
15,865 ft. 68 in. wood stave pipe, complete		131,561.78	
1902 ft. 48 in. steel pipe, with Y connection, valves and cross-over to smaller pipe		19,587.27	
Two 36 in. standpipes, 65 and 70 ft. high		2,316.31	
16,816 lineal ft. grading and filling		61,530.44	
Cedar Falls Generating Station, total	13,500	354,387.44	26.30
Power House Buildings, Station, Switch House, Transformer House and Freight Shed		47,829.77	
Employes' Cottages		10,386.82	
Two 8000 h.p. turbines with hydraulic valves, governors and relief valves, complete in place	10,000	53,296.55	5.33
Two 2400 h.p. Pelton wheels, with valves and governors, complete	3,500	28,200.00	8.05
Two 5000 kw. generators, complete in place	10,000	39,422.00	3.94
Two 1750 kw. generators, complete in place	3,500	23,782.00	6.50
Two 75 kw. exciters, with Pelton wheels and governor	150	5,383.00	35.80
One 150 kw. exciter with Girard wheel	150	4,500.00	30.00
Switchboard, complete	13,500	11,042.45	.82
2300 volt wiring, busses and switches	13,500	30,348.29	2.25
Nine 1500 kw. 60,000 volt transformers, in place	13,500	74,649.17	5.54
60,000 volt wiring and switches	40,000	25,547.79	.64
Transmission Lines, total	40,000	232,629.62	5.82
No. 1 transmission line, total	13,000	119,012.72	9.18
Right of way for both lines		40,490.39	
1515 poles and arms, in place		21,584.04	
4605 insulators		19,938.29	
117,500 lbs. No. 2 copper wire		28,480.24	
Two telephone lines; one of No. 10 copper, one of No. 14 iron, on power line poles, complete		8,519.76	
No. 2 transmission line	27,000	112,889.99	4.18
732 poles, with arms, in place		21,943.69	
2256 insulators, in place		7,699.37	
374,700 lb. No. 4-0 stranded copper wire		78,044.53	
Telephone line 3/16 in. plow steel cable, on power line poles		4,475.49	
Linemen's cottages, incomplete		726.91	
City Substations, total	12,000	242,096.21	20.17
Main substation, Seventh avenue and Yesler Way, total	12,000	216,063.89	18.00
Substation building		30,081.26	
60,000 volt switches and wiring	40,000	7,250.00	.18
Eight 1500 kw. 50,000 volt transformers in place	12,000	56,350.00	4.69
15,000 volt and 2500 volt wiring and switches	12,000	46,155.83	3.85
Station switchboard	12,000	17,500.00	1.46
Twelve 2500 volt feeder regulators on commercial circuits	600	14,750.00	24.58
500 kw. direct current motor generator set	500	15,500.00	31.00
Twelve 100-lamp constant current transformers with switches and wiring	720	15,250.00	21.20
500 ampere hour 500 volt storage battery	500	11,576.80	23.15
60 kw. motor generator	60	1,650.00	27.50
Four outlying substations	3,300	26,032.32	7.90
Seven 15,000 to 2500 volt transformers, total 3300 kw.	3,300	15,582.26	4.73
Five constant current transformers, complete	300	4,925.00	16.42
Three 2500 volt feeder regulators	150	3,330.00	22.20
Station wiring and switches	3,300	545.06	.16
Four buildings, corrugated iron		1,650.00	
Lake Union Auxiliary Station	1,900	95,550.32	50.30
Building complete	1,900	10,044.45	5.27
2500 h.p. Pelton-Francis water wheel with governor and valves complete	1,900	8,914.82	4.80
1500 kw. 2500 volt alternator with exciter, complete	1,900	10,675.85	5.62
Station, wiring, switches and switchboard	1,900	8,150.25	4.30
3400 ft. 40 in. steel penstock, complete, 400,000 lbs.	1,900	41,456.51	21.80
Special tie-line, 2500 volt two-phase, 819,000 c.m. aluminum, complete		16,308.44	
Commercial Circuits, including Commercial Poles, total		966,906.87	
15,000 volt distributing system, total	6,000	69,874.17	11.65
122 miles bare copper wire, No. 2 to 4-0, in place, 142,400 lbs.		36,136.08	

Division of Plant.	Capacity kw.	Cost.	Unit-Cost (per kw.)
15,000 volt insulators and pins		4,377.12	
25 transformers, 25 kw. to 600 kw., total 2950 kw., complete in place	2,950	11,537.89	3.92
37 out-door disconnecting switches, 1 to 5 pole		4,630.39	
555 poles, 3.4 per cent of all poles, in place		13,192.69	
2500 volt distributing system	10,000	427,793.01	42.78
584 miles weatherproof copper wire, No. 6 to 350,000 c.m., in place		181,917.18	
2500 volt insulators and pins		22,602.85	
1256 transformers, 2 kw. to 50 kw., total 10,364 kw., in place	10,364	123,778.12	11.83
4183 poles, 25.8 per cent of all poles, in place		99,494.86	
120-240 volt secondary system	10,364	429,453.59	41.40
1310.5 miles weatherproof copper wire, No. 6 to 4-0, in place		230,408.15	
Insulators and pins		41,008.02	
poles, in place		158,037.42	
Direct Current Circuits	1,000	39,786.10	39.78
34 miles weatherproof copper wire, No. 1 to 350,000 c.m., in place		31,361.38	
Insulators and pins		4,302.00	
173 poles, 1.17 per cent of all poles, in place		4,122.72	
Installations, Light and Power, total	23,225	616,416.25	26.50
Business Light Installations	3,425	61,027.17	17.85
2077 services		25,116.50	
2077 meters in place		25,806.32	
50,588 carbon lamps		7,527.68	
94 arc lamps, complete		2,576.67	
Residence Light Installations	13,600	507,204.36	37.30
23,100 services		165,711.06	
23,100 meters		298,154.16	
303,063 gem carbon lamps, 4,536,000 c.p.		43,339.14	
Power Installations	6,200	47,435.59	7.65
455 services		10,571.10	
910 meters		19,552.80	
81 motors, ½ to 25 h.p., total 499½ h.p. in place		17,132.19	
Domestic Power Installations	72	749.13	10.40
19 services		388.32	
19 meters		360.81	
Series Street Lighting System		358,049.33	
645 miles No. 6 weatherproof copper wire in place		128,469.80	
Insulators		31,100.00	
929 arc lamps, complete, in place		37,337.33	
5876 50 w. tungsten series incandescent lamps with fixtures, in place		51,203.12	
4622 poles, 2-7 of all poles in place		109,939.08	

	Cost.	Cost per Pole
Cluster Lighting System	$398,165.94	$235.50
1,692 iron cluster poles	61,322.50	36.25
1,692 sets globes, lamps, wiring	22,767.69	13.45
1,126 pole-base transformers, 250 w	9,639.54	5.70
57,081 ft. lead covered 7500 volt cable	27,701.98	16.35
159,766 ft. secondary cable	41,814.45	24.70
29 oil switches	1,663.00	1.00
69 manhole transformers, 810 kw	11,747.85	6.95
222,789 ft. black iron conduit	84,633.22	50.00
151,764 ft. fibre pipe in concrete	25,119.11	14.85
89 manholes	16,850.39	9.95
873 handholes	17,368.90	10.25
124 junction boxes	2,689.30	1.60
283 cu. yd. concrete	2,202.83	1.30
21,766 cu. yd. excavation	16,998.21	10.00
13,583 sq. yd. cement sidewalk relaying	14,354.88	8.50
63,000 board feet sidewalk relaying	662.57	.40
3,771 sq. yd. repaving	11,051.19	6.55
30,000 board feet planking street	255.48	.15
1,692 sets bolts and anchor plates	1,579.72	.95
Clearing, fixed estimates and Incidentals	27,743.13	16.40
Underground Conduit System, Commercial	125,797.73	
102 manholes	24,887.43	
62 handholes	3,802.24	
249,979 ft. vitrified clay duct	60,381.49	
120,000 ft. black iron conduit	36,727.57	
Storeroom	774.44	

Unit Cost of Distributing System.

On basis of 17c Copper.
Allowing 5 per cent for sag and corners.
Does not include Overhead Charges.

2500 Volt Primaries, Triple Braid—Weatherproof.

Size and No. of Wire.	Weight per 1,000 ft.	Cost per Thousand Feet. Wire.	Labor.	Insulators.	Total.
Two No. 6	224	$ 40.00	$4.50	$1.10	$ 45.60
Two No. 4	328	58.55	4.70	1.10	64.35
Two No. 2	520	92.80	5.50	1.20	99.50
Two No. 1	632	112.80	6.00	1.20	120.00
Two No. 0	814	145.30	7.60	1.20	154.10
Two No. 00	1,004	179.20	8.10	1.40	188.75
Two No. 3-0	1,258	224.55	8.60	1.50	234.65
Two No. 4-0	1,534	273.80	9.40	1.70	284.90
Two 350,000Cir.Mil	2,690	480.15	44.00	2.00	526.15

120-240 Volt Secondaries.

One No. 6	112	20.00	3.40	.45	23.85
Two No. 6	224	40.00	4.40	.90	45.30
Three No. 6	336	59.95	4.90	1.35	66.20
One No. 4	164	29.30	3.60	.45	33.35
One No. 4 and one No. 6	276	49.25	4.50	1.35	55.10
Two No. 4	328	58.55	4.60	.90	64.05
Two No. 4 and one No. 6	440	78.55	5.20	1.35	85.10
Two No. 4 and one No. 4	492	87.80	5.40	1.35	94.55
Two No. 3 and one No. 4	562	100.35	6.00	1.45	107.80
Two No. 2 and one No. 4	684	122.10	6.50	1.45	130.05
Two No. 2 and one No. 2	780	139.25	7.05	1.50	147.80
Two No. 1 and one No. 6	744	132.80	6.80	1.45	141.05
Two No. 1 and one No. 4	796	142.05	7.00	1.45	150.50
Two No. 1 and one No. 1	948	169.20	7.80	1.50	178.50
Two No. 0 and one No. 2	1,074	191.75	9.15	1.50	202.40
Two No. 0 and one No. 4	978	174.55	7.20	1.45	183.20
Two No. 0 and one No. 1	1,130	201.70	9.40	1.50	212.60
Two No. 00	1,004	179.20	8.10	1.20	188.50
Two No. 00 and one No. 4	1,168	208.50	9.20	1.65	219.35
Two No. 00 and one No. 1	1,320	235.60	10.00	1.70	247.30
Two No. 4-0 and one No. 1	1,850	330.20	11.40	2.10	343.70
Two No. 4-0 and one No. 0	1,941	346.50	12.20	2.10	360.80
Two No. 4-0 and one No. 00	2,036	363.40	12.50	2.20	378.10

250-500 Volt Direct Current System.

Size and Number of Wire.	Weight per 1000 ft.	Cost per Thousand Feet. Wire.	Labor.	Insulators.	Total
Two No. 4	328	$ 58.55	$4.60	$0.90	$ 64.05
One No. 2	260	46.40	4.00	.50	50.90
Two No. 2	520	92.80	5.50	1.00	99.30
Three No. 2	780	139.20	7.05	1.50	147.75
Two No. 1	632	112.80	6.00	1.00	119.80
One No. 0 and one No. 4	571	101.90	6.10	1.00	109.00
Two No. 0	814	145.30	7.60	1.00	153.90
Three No. 0	1,221	217.95	10.20	1.50	229.65
One No. 00 and one No. 0	909	162.25	7.10	1.10	170.45
Two No. 00	1,004	179.20	8.10	1.20	188.50
Three No. 00	1,506	268.80	11.10	1.80	281.70
One No. 4-0	767	136.90	5.90	.80	143.60
One No. 4-0 and one No. 00	1,269	226.50	8.75	1.40	236.65
Two No 4-0	1,534	273.80	9.40	1.60	284.80
Two No. 4-0 and one No. 1	1,850	330.20	11.40	2.10	343.70
Two No. 4-0 and one No. 00	2,036	363.40	12.50	2.20	378.10
Three No. 4-0	2,301	410.75	13.20	2.40	426.35
Two 350,000 C.M.	2,690	480.15	42.00	2.00	524.15
Two 350,000 C.M. and one No. 4-0	3,457	617.05	46.40	2.80	666.25
One 400,000 C.M.	1,553	277.20	18.00	1.00	296.20
Two 750,000 C. M.	5,644	1,007.45	48.00	2.20	1,057.65

Series Street Circuits.

Wire.	Weight per 1000 ft.	Cost per Thousand Feet. Wire.	Labor.	Insulators.	Total.
One No. 6	112	$20.00	$3.40	$0.55	$23.95
Two No. 6	224	40.00	4.40	1.10	45.50

15,000 Volt System—Bare Wire.

One No. 2	201	$ 35.90	$ 5.10	$ 2.10	$ 43.10
Two No. 2	402	71.80	6.90	4.20	82.90
Three No .2	603	107.65	8.50	6.30	122.45
Four No. 2	804	143.50	10.50	8.40	162.40
Five No. 2	1,005	179.40	12.20	10.50	202.10
Four No. 1	1,014	181.00	12.50	8.40	201.90
Four No. 0	1,278	228.10	14.50	9.00	251.60
Four No. 00	1,612	287.75	16.50	10.00	314.25

Wage Schedule for Line Work 1912—Eight Hour Day.

Line foreman	$4.75
Lineman	4.20
Groundman	2.75
Pole foreman	3.25
Poleman	2.75
Teamster	2.75
Teamster and team	5.00
Laborer	2.75

Cost of Insulators.

Type.	Where Used.	Largest Wire.	Voltage.	Cost Each
Pittsburg, 196	Trans. lines	No. 4-0	60,000	$1.275
Pittsburg, 71	15,000-V. lines	No. 4-0	15,000	.30
33 Brown	Primaries	No. 0	2,500	.04685
42 Brown	Primaries	350,000 C. M.	2,500	.04960
Street Railway	D. C. and Secondaries	No. 0	250-125	.0370
Hemingray Cable	D. C. and Secondaries	750,000 C. M.	500-125	.08281
38 Drab	Street Circuits	No. 6	3,500	.048685

Cost of Poles—1912 Average.

Includes Overhead Charges.

Length Feet.	Foreman.	Poleman.	Lineman.	Labor Cost. Team.	Total	Total Cost. Pole Cost.	Pole in place.
40	$0.65	$4.05	....	$1.87	$ 6.57	$ 5.17	$11.74
45	.67	4.52	....	1.55	6.14	6.11	12.85
50	.81	4.66	.31	2.07	7.85	6.77	14.62
55	.92	5.94	.36	2.47	9.69	8.03	17.72
60	1.44	5.96	1.31	2.56	11.27	9.46	20.73
65	1.34	7.94	.72	4.19	14.19	10.28	24.47
70	1.52	8.90	1.09	3.55	15.06	13.48	28.54

Cost of Installations, 1913.

Installations include service from pole to building, meter, lamps supplied by the Department. To these costs 10 per cent should be added for superintendence and tools.

	Payroll.	Material*	Miscellaneous.	Total.
Business installations	$2.576	$14.624	$0.375	$17.575
Residence installations	2.018	11.116	0.288	13.422
Power installations	3.581	26.873	0.425	30.880
Domestic Power installations	5.181	26.861	0.617	32.660

*Includes meters and lamps.

EXPERIMENTS WITH SUSTAINED HIGH-FREQUENCY HIGH-VOLTAGE.

BY J. C. CLARK.

(This is the second of a series of articles concerning the marvelous experiments with high voltage at high frequency which are being conducted at Stanford University under the direction of Prof. Harris J. Ryan, assisted by Prof. Clark. Subsequent articles written by Prof. Ryan will take up the high potentiometer and its application in determining the voltage duty of the units in suspension type insulators. The articles are not only of intense theoretical interest but of great practical value in determining why insulators fail.—The Editor.)

A previous article by the writer described the apparatus dveloped in the Electrical Engineering Laboratory at Stanford University for the generation of sustained high-frequency high-voltage. It is the purpose of the present article to describe the principal experimental work which has been performed with this apparatus.

It is desirable to acquaint the reader with some of the more striking properties of the sustained high-frequency voltage, and current, insofar as these properties are dependent on the frequency. It is necessary to remember throughout that the frequencies used in these experiments range from about 75,000 to 615,000 cycles per second; or, roughly, from 1000 to 10,000 times the frequency of 60 cycles commonly used in transmission. It is difficult, even for one daily engaged in work with high-frequency apparatus, to grasp the entire significance of this enormous increase in frequency, and to form any adequate conception of the manner in which certain low-frequency effects are intensified thereby.

It is a well known fact that a given condenser will take, at a given alternating voltage, a current which is directly proportional to the frequency. At ordinary commercial frequencies, this fact is of little practical significance; and it is only in the cases where the actual capacity of the condenser is great, as in very long transmission lines, or in long underground cables, that the charging current becomes a factor with which serious reckoning must be made. However, at the high frequencies developed in these experiments, even a very small capacity takes a relatively large charging current. For example, a pair of seven inch copper spheres, separated 3 inches, takes at 100,000 volts, r.m.s, and 100,000 cycles, a charging current of approximately one ampere. In the use of the sphere-gap voltmeter on high frequency this relatively enormous charging current to the spheres prohibited the use of carborundum rods as resistance to limit the current on gap discharge; owing to the fact that the large amount of power consumed in the rods (enough to heat two of them in series to a bright red) prevented satisfactory operation of the arc generator. Accordingly fine wire fuses, guarded to prevent corona, were substituted for the rods as a means of limiting the current on gap discharge. Masses of wood, or other hydrocarbonous material, placed in such a position as to concentrate the charging current flowing between parts of the circuit operating at considerable potential difference, often exhibit disagreeable effects, such as charring and burning of the material. Whenever such material must be used as insulation, it is necessary to exercise the greatest care in designing the parts of conductors coming in contact with the material in such a manner that no undue concentration of the charging current at the contact is permitted.

It was apparent at the very beginning of the experiments that the high frequency voltage possessed remarkable corona developing properties. It is not to be inferred from this that the start of corona occurs at any lower voltage with high-frequency than with low-frequency, but that the importance of the so-called "local" corona is tremendously enhanced with the great increase in frequency. The result is that any corona developing conductor is capable of exercising exceedingly destructive effects when it is allowed to play the corona upon insulation of any kind. The sequence of effects is apparently: (1) ionization, (2) heating, (3) destruction. It should be noted, however, that here as in handling low-frequency high-voltage local corona formation may be prevented by proper dimensioning of parts. For example, there is complete absence of corona formation upon the spheres of a sphere-gap prior to discharge, when it is used with gaps not exceeding the diameter of the spheres.

The high frequency voltage exhibits an ability to jump very large gaps between blunt points. Fig. 1 is

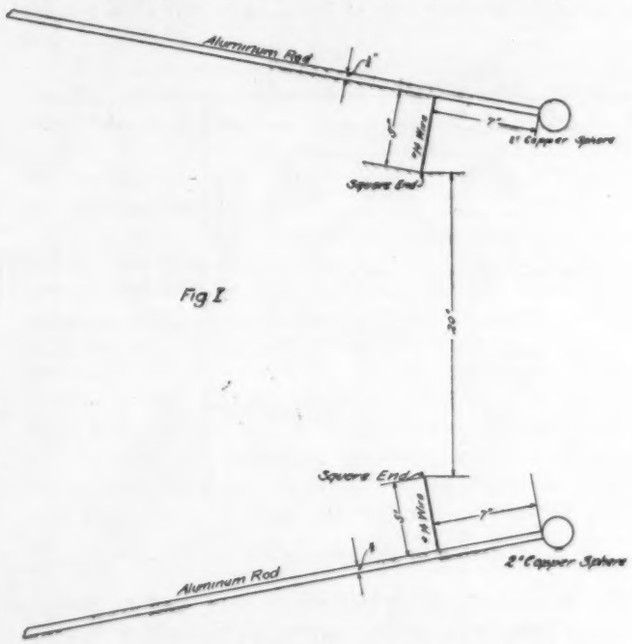


Fig I.

Fig. 1. Apparatus Demonstrating Ability of High Frequency Voltage to Jump Large Gaps Between Blunt Points.

a drawing showing the arrangement of apparatus in a test to demonstrate this fact. To jump this 20 inch gap with high frequency requires only 80,000 volts r.m.s., while to jump the same gap at 60 cycles would probably require over 200,000 volts. It should be noted that the arrangement here is such as to shield the projecting gap terminals somewhat, and the effect of such an arrangement is, of course, to increase the voltage required for the given gap beyond that which would be required if the connections were brought to the terminals in the most favorable way; i. e., in line with the terminals.

It is found that coronas may be started in the following manner upon a conductor the dimensions of which are such as normally to render the conductor

corona-free. When any bulky object is brought up close to the conductor, an arc will jump to the object, and continue to run, whether or not the latter is connected to the opposite side of the circuit. This is apparently due, in the case of a non-conductor, to the concentration of electric field through the object owing to its possessing greater specific inductive capacity than the surrounding atmosphere. In the case of a conductor, it is evidently due simply to the increased area offered for the circulation of charging current between the two sides of the circuit. When the bulky object is withdrawn, the arc is, of course, broken; but a vigorous corona brush generally remains in place of the arc. With the breath one may

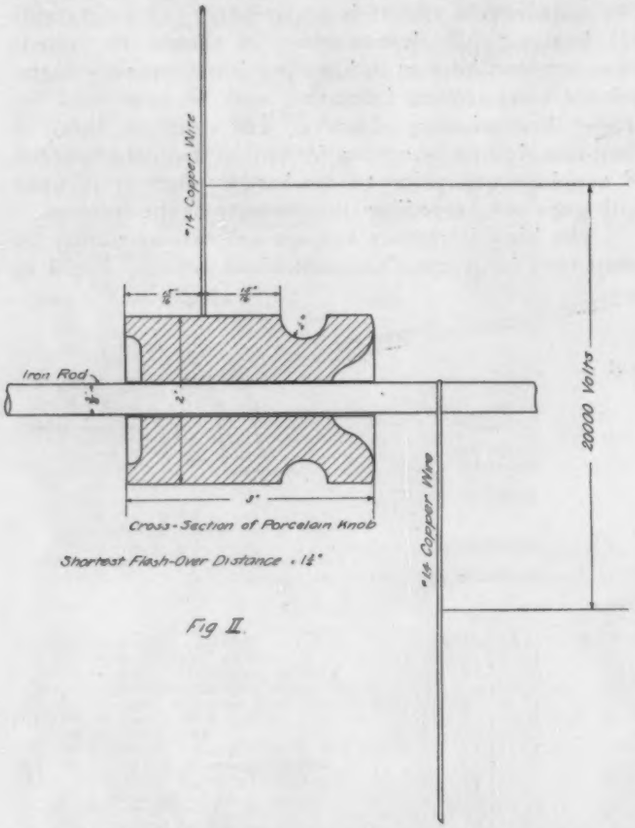


Fig. II.

Fig. 2. Mounting of Porcelain Knob for Puncture Test.

blow this brush along the conductors, and frequently it may readily be blown into a region which is especially well adapted by its dimensions or arrangement to withstand the start of corona.

A large part of the work thus far done with the equipment has consisted in making qualitative observations of the effect of applying high-frequency high-voltage to samples of glass or porcelain. All available samples of these materials are very easily and quickly punctured, and sometimes shattered, when blunt metallic terminals carrying the high-frequency voltage are placed opposite each other, and resting upon the surface of the sample.

When approximately 20,000 volts, r.m.s., at 100,000 cycles are applied to plate glass 3/8 in. thick by means of blunt points resting against the surfaces opposite each other, the first effect observed is merely the spread of the charging current taken by the glass away from the contact points in the form of a vivid corona display over a very limited area. After this has persisted for about five seconds, a conducting puncture is formed between the points, and the path of the subsequent current through the glass glows at white heat. It is difficult to maintain the arc-generator in operation after the breakdown has occurred owing to the disturbance of the oscillatory circuit due to the short circuiting of the inductance by the hot conducting glass. Upon drawing one or both electrodes away from the specimen in order to lengthen the arc, and thus remove the short circuit from the inductance, the action of the oscillatory circuit is restored, and one may then play a long, hot arc upon the test specimen.

A particularly interesting characteristic of the high-frequency high-voltage is its propensity for puncturing sheet insulating materials such as plate glass in the atmosphere rather than to flash over the surfaces and around the edges. Those who are familiar with the manner in which 60 cycle high voltage produces flashovers in preference to puncture are especially impressed with the opposite tendency of the high-frequency high-voltage. For example, a piece of plate glass 3/8 in. thick may easily be punctured at a distance of 1½ in. from the edge, whereas this is possible with low-frequency voltage only when the test specimen is immersed in oil. This tendency is further illustrated by Fig. 2 which shows the mounting of a porcelain knob for test; 20,000 volts rm.s., at 100,000 cycles will form a puncture directly through the porcelain with almost complete absence of flash over between terminals although the flash over distance is extremely small.

The process of puncturing a piece of electrical porcelain is similar to that of puncturing glass, except that porcelain is considerably the tougher material. This superior toughness of porcelain is especially manifest when the puncture is practically completed, as it often shows little evidence when cold that puncture has occurred. Often it requires the re-application of the high-frequency voltage to disclose the fact that the porcelain has already been punctured. Upon this re-application, however, the old puncture immediately manifests itself as a glowing core of molten conducting material.

The constitutionality of the Idaho public utilities law has just been sustained by the Supreme Court of Idaho. The public service commission has issued orders shutting the Idaho Power & Light Company out of Twin Falls and the Beaver River Company out of Pocatello for the reason that they have not secured from the commission certificates of necessity and convenience as provided by law. The Great Shoshone & Twin Falls Water Power Company was already in Twin Falls, and the Southern Idaho Water Power Company was in Pocatello. The new applicants promised lower rates and better service. The effect of the decision is to give the commission absolute power in matters of this kind. The opinion was written by Justice Sullivan and concurred in by Judge E. A. Walters of the fourth district, sitting for Justice Stewart, who is ill. Chief Justice Ailshie dissented from the majority opinion.

P. P. I. E. MACHINERY EXHIBITS

THE DIESEL ENGINE.

The center of the Palace of Machinery at the Panama-Pacific International Exposition will be occupied by a 500 brake horsepower Diesel engine built by the Busch-Sulzer Bros.-Diesel Engine Company, St. Louis, the pioneers of the Diesel engine in America. This was the first exhibit to be installed, ground having been broken and the first pile driven May 27th with much ceremony; engineers and city, state, federal and exposition officials in attendance.

The engine will be direct connected to a Westinghouse type "Q" direct current generator, driven at 200 r.p.m. and developing 335 kw. at 250 volts. This generator is characterized by perfect commutation with brushes remaining in a fixed position from no load to heavy overload, excellent ventilation and low temperature rise and minimum weight. It will be a working exhibit, valued at $70,000, which will "tie in" with the regular electrical load of the Exposition and do its share supplying that which has become so vital a factor in the life of these colossal expositions—electricity.

The exhibit will afford every opportunity to study the engine which epitomizes the accumulated experience of fifteen years of Diesel building. The exhibit will be surrounded with charts illustrating the dominant features of fuel consumption very nearly in direct proportion to load—the engine's unique ability to maintain a fuel economy, which, anywhere between a load equal to half the capacity of the smallest unit up to the full capacity of the plant, assures a thermal efficiency equal to operation at full load at all times. The exhibit will be supplemented with photographs of Diesel installations in twenty-six states showing types, methods of operation, and diversity of application. Every endeavor to make it intelligible and worth while to engineer and layman alike will be made.

There are two distinct fields in which the Diesel engine excels; first, for auxiliary or stand-by service; second, for continual operation with a constant and full load. As an auxiliary or emergency unit the engine cuts out all "stand-by losses," wasted fuel in keeping up steam and the extra attendance required for this purpose. A twist of the wrist starts the engine, and full load may be pulled from the start. The engine feeds fuel to itself automatically, and there is no labor incident to its operation.

For a heavy, steady drag its extraordinary saving of fuel and labor is most noticeable. The capital charges are smallest per unit of power developed, and the engine may be depended upon for the longest, severest non-stop runs of six weeks to two months.

The governor of the Diesel engine measures the amount of fuel burnt, just enough being injected on any one stroke to meet the requirements of that particular moment. While this method of governing is largely responsible for fuel consumption in direct proportion to the load, it is only particularly responsible for its notable economy, the main causes being completeness of combustion with almost complete utilization of the resulting heat, and the great cheapness, abundance and variety of all such oils as are suitable fuel for it.

The temperature of the air change in the cylinder at the end of the compression stroke and just previous to the injection of the fuel is 1000 degrees F. This is a temperature 3 to 8 times that actually required for the ignition of the fuel charge, as fuel oils ignite at temperatures ranging from 120 to about 325 degrees F. This temperature of 1000 degrees, of course, eliminates completely all ignition devices, be they electrical, hot hulb or tube, and assures combustion in an atmosphere which may be described as incandescent, a condition which is ideal and assures perfect combustion, smokeless exhaust and the highest thermal efficiency so far known to the engineering world.

The injection is accomplished gradually by means of an air blast, the fuel entering slowly and burning gradually, giving a smooth crank effort in the same manner as the gradual introduction of steam in the steam engine. Each little atomized particle of oil burns from its surface and is not entirely consumed until the end of the power stroke and the opening of exhaust valves.

It is this principle of combustion which accounts for the magnificent regulation possible with this newest type of prime mover. Whether 2-stroke or 4-stroke, with these exceptions the cycle of the Diesel engine is otherwise very similar to that of the gas or gasoline engine.

For atomizing the fuel by an air blast the Diesel engine requires an air compressor, which, as in the case of the engine to be exhibited by the Busch Company at the Panama-Pacific Exposition, is integral with the engine proper, being actuated by a crank on the main shaft. Each of the four cylinders of this engine is 19½ x 24 in., and each is capable of developing 125 brake horsepower at a speed of 200 revolutions per minute. The base is enclosed, and forced lubrication under a pressure of 30 pounds is provided. The cam shaft for actuating the valves is carried on brackets at the side of cylinder heads and is entirely enclosed. The cylinders, of course, are water jacketed, but so are the exhaust manifold and piping, thus affording an opportunity for the fullest recovery of heat lost to cooling water. Further recovery of lost heat may be provided for by passing the water thus heated through a water jacketed exhaust muffler or "exhaust gas heater economizer" where the same may be raised to near the boiling point. This hot water may then be used in processes of manufacture, in the heating of buildings, and for boiler feed where steam is also required.

In the very best of steam plants but 18 per cent of the total heat value of the fuel consumed is ever converted into power, while average steam plants show an efficiency ranging from 6 per cent to 8 per cent. Contrast this with the 32 to 25 per cent thermal efficiency of the Diesel engine, then add to this an additional 27 per cent recoverable from jacket cooling water and 21 per cent from exhaust gases. Fully 80 per cent of all the fuel consumed in a Diesel engine may be conserved to useful purposes.

PUBLIC POLICY OF PUBLIC UTILITY CORPORATIONS

THE TELEPHONE PROBLEM.

BY. D. P. FULLERTON.

(This article constitutes a clear-cut analysis of the difficulties which the telephone company has to meet in educating the public in the proper use of the telephone. How these problems are solved should be of intense interest to all other utilities. The author is division superintendent of the Pacific Telephone & Telegraph Company and presented the paper at the April 24, 1914, meeting of the San Francisco A. I. E. E. Section.—The Editor.)

The difficulties of engineering telephone problems are probably less known and less appreciated, both by the layman and by engineer of other arts, than any other branch of electrical engineering.

Telephone engineering requires the systematic planning of a public service which is operated principally by the untrained public. The engineers engaged in planning other forms of public service know that while the work they are engaged upon is primarily for the benefit of the public, the plant they produce will be operated almost entirely by trained employes. Consequently, if there is any decline in the character of the service rendered, little, if any, of the blame can be traced to the participation of the public in the operation of the service. On the other hand, if the employes operating the service are doing so efficiently, there is little that any one person can do that will render the service inefficient to the public as a whole, or in any way place the burden of responsibility upon the plant of the company supplying the service.

In supplying telephone service this condition is entirely reversed, for no matter how efficiently a properly designed telephone plant may be operated in part by the employes of the company, the use made of such facilities by the public determines its efficiency and the company invariably and unjustly bears the burden of the responsibility. Consequently, the greatest problem that confronts the telephone engineer is to devise a plan to systematically and efficiently educate the public in the use of a telephone system.

The average person will admit he knows nothing of the mysteries of the electric light, the street railway, the telegraph, the gas or the water service, and will admit that it requires specially trained people to provide these services and to operate them, and the advice of such people as to the use of such utilities will be heeded generally without question, but for any trained employe to intimate to the public that the self same public does not know how to use a telephone means that that employe begins to earn his salary right there.

While the telephone engineer has many problems to solve, the greatest one—the one that so far has not been mastered—is the education of the public in the use of the telephone and an endeavor to have the public co-operate with the company in its effort to provide a service satisfactory to all. As a matter of course, all of his problems have a distinct relationship one with another, and while such engineering questions as transmission, distribution, and operation are sufficiently complex in themselves, they are rendered more difficult of solution by the ever attendant problem of public relations and education of telephone small units with which the telephone engineer must deal.

A comprehensive telephone service is designed upon the primary base of its use by a great number of persons, a great number of times, and for very small units of time. This very characteristic must demonstrate that this can only be done with a multitude of units which, owing to the nature of the utility, are very small. A little thought given to this question will develop that in the matter of providing telephone service, more units, and units of less size, are required in the telephone business than in most any other, and surely than in any other public utility.

Pacific Statistics.

In dealing with these telephone facts I do not intend to present to you a mass of telephone statistics gathered from the telephone world, but to confine myself as much as possible to facts and figures, so far as statistics may be concerned, to those of a local character; in other words, a home product, and consequently will tell of some of the facts and some of the problems of the company with which I am connected—the Pacific Telephone & Telegraph Company.

Practically every person who is actively engaged in business has a telephone at his elbow. From the company's viewpoint, the telephone at your elbow is a decidedly small part of the equipment necessary in supplying telephone service and the object of my talk is to give you an idea of some of the problems of the telephone company which lie beyond the telephone you use and of how these problems are met. I might say right here that the function of any telephone company is to provide satisfactory service to the community it serves in such quantities as may be required by the various classes of telephone users and at such rates as will permit paying a fair wage to its employes and a small and fair return upon the capital invested. For the Pacific Company to do this it is necessary that its plant be made up in part of a multitude of the small units, to which I have referred.

This company has connected in its service subscribers stations that it owns to the number of 547,874, and connecting with its exchanges but owned by connecting companies, 104,032, making a total of stations served by it—651,906. To give a universal service to its owned and connected stations the Pacific Company has 897,509 poles, or approximately 24,257 miles of pole line, nearly enough to encircle the earth, and in its underground and aerial wire plant it has a total of 1,806,169 miles of wire, the major portion of which is No. 22 gauge and none larger than No. 8 gauge copper and No. 6 gauge iron. Of this amount 224,896 miles are in open wire construction, 509,897 in aerial wire and 1,065,257 in underground cable and 6119 miles in submarine cable. It has 3614 miles of single duct underground conduit occupying 810 miles of street, or a distance greater than from San Francisco to Portland, Ore., while the single duct, if connected in line, would reach from San Francisco to Chicago.

The subscribers stations referred to are served by the wire plant just enumerated through the medium of 607 exchanges and 1076 toll stations, with an auxiliary of 4047 private branch exchanges. The 547,874 stations of the telephone company and the 104,032 connecting stations represent approximately 650,000 subscribers who are connected by 252,976 exchange lines and which are given service from the central office through switchboards ranging in capacity from one operating position to those requiring several hundred positions.

A description of the multitude of small units required to make up the average central office would be a subject in itself and time will permit only of brief reference. It may be interesting to know that the wire mileage within our central office switchboards is approximately 250,000 miles. Connected with this wiring are 330,000 answering jacks and 5,580,000 multiple connecting jacks, 1,500,000 relays of various types, 1,200,000 24 volt lamps and a proportional amount of cords, keys, resistances and impedance coils and apparatus of a like character. This plant provides service for the 650,000 stations connected with it by completing 770,000,000 exchange calls and 16,000,000 toll calls each year. In addition to the completed calls handled, a great many calls which are not completed, due to the fact that the subscribers' lines are busy or the subscribers are out, are also handled. About 25 out of every 100 local calls made cannot be completed upon first attempt and between 12 and 15 of these 25 calls fail because the line called for is already busy. About 8 to 10 fail because the person called does not answer or is so slow in answering that the calling party hangs up and abandons the call.

Operating Methods.

The nature of the telephone service is such that it is necessary to promptly complete each call received. It is also necessary to maintain a uniform and efficient service each hour of the day and each day of the year, and we must be prepared for the unexpected as well as for the usual. Switchboards, trunks, toll circuits and operators are required to handle a maximum traffic at any period of any day and for the heaviest days. Each day has its busy and its slack hours; for example, in one of our offices we handle nearly 10,000 calls between 10 a. m. and 11 a. m. and in the same office we handle 2000 calls between 6 p. m. and 7 p. m. To meet these expected fluctuations is part of our daily work. However, we must be prepared to meet unusual conditions and emergencies; unexpected storms, large fires, extremely hot or cold days, make sudden and heavy demands upon the system. By arranging our operating loads, by keeping reserve apparatus and a reserve force within call, we are able to meet all emergencies.

It is to be expected that in handling this large volume of traffic some mistakes will be made and it may appear surprising to state that our records show that the subscribers make as many mistakes as the operator. The operator must proceed instantly with every call and handle the varying conditions which arise without waste of time in trying to decide what to do. It is necessary, therefore, to have detail methods and rules covering each operation prescribed in advance if a thoroughly efficient and reliable service is to be given to the subscriber. For this purpose standard local operating methods, which are the result of extended study, have been developed by the traffic engineers, which will result in the most satisfactory service to the public. They are designed to protect the subscriber in every feasible way from disturbances due to the action of other subscribers or from the action of the operating force.

A great many people consider an operator at the central office as a mere machine. It is true that she does the same thing over and over many times day after day, but she is much more than a business machine. The operator deals with people of various nationalities and tempers and she is expected to be just, considerate and courteous at all times. The operators are a carefully selected and trained body of young women who are given a thorough course in our operating school before they are permitted to engage in the actual work of operating. The school course requires about four weeks and is designed to teach the fundamental principles of telephone operating, as well as the actual handling of the apparatus under conditions as nearly like the actual work of serving subscribers as possible.

Voice culture is given special attention, so as to develop correct enunciation. Their working surroundings have been planned with every attention to efficiency and comfort. All the complicated equipment of the operating room, even to the chairs in which they work, has been engineered with the idea of permitting the operators to furnish the best service with the greatest possible ease. The physical conditions under which the operators work are very favorable and the comfort and welfare of the operators is given special attention.

Anticipation of Service Requirements.

The operations of the Pacific Telephone & Telegraph Company extend over the entire coast, from Canada on the north to Mexico on the south, embracing the four greatest states of California, Oregon, Washington and Nevada and a portion of the state of Idaho. This vast area, 1100 miles from north to south, 535 miles from east to west at its widest point, embraces some 458,700 square miles, representing 1/7 of the total area of the continental United States. The population in this section has increased in the last six years from 3,800,000 to 5,200,000, or 36 per cent, while the population in the continental United States has increased over the same period only 16 per cent.

Consequently, one of the problems is to determine where the customers for telephone service would be located so the necessary facilities can be provided. Manufacturers and merchants can ordinarily control or regulate the growth of their business and can generally wait until they have business in sight before making extensions of plant, or they can rent quarters for temporary busy periods and go back to normal conditions when the rush is over, but the public utilities, particularly the telephone company, must, under the law, be ready with reasonable promise to serve a customer on demand in any part of the territory in which it operates.

[To be continued]

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CONTENTS

The Eastwood Multiple-Arched Dam 49
By John S. Eastwood.

Electric Floats at Portland 52

Cash Investment of the Railways During Six Years 52

Electrical Demonstrations 54
By E. L. Arnold and D. B. Munroe.

Mexican Turbine Runner Cannon 54

The Magnetic Quality of Iron 54

Hydroelectric Cost Data 55
By J. D. Ross.

Experiments With Sustained High Frequency High Voltage. 57
By J. C. Clark.

The Constitutionality of the Idaho Public Utilities 58

The Diesel Engine 59

The Telephone Problem 60
By D. P. Fullerton.

Editorials 62
Water Wheel Prayers.
Engineering Honesty.
Applied Knowledge.

Personals 64

Meeting Notices 65

Electrical Contractors' Department 66
Co-operation Between Electrical Contractors and Jobbers.

Electrical Contractors' Notes 68

Ruling San Francisco Department of Electricity 68

Trade Notes 68

News of the California Railroad Commission 68

Applied Knowledge

The mere possession of information, knowledge acquired passively, is worth as little as the mere hoarding of money. But when such passive knowledge becomes active, when it is used, when it has entered directly into one's life, it becomes exceedingly valuable. It is not what a man knows, but what he does with what he knows. Use is the measure of value.

Experience is applied knowledge. On the basis that it is worth what it costs, experience is man's dearest possession. But the wise man applies the knowledge of others so that it becomes a part of his experience. Wisdom may be defined as the right use of knowledge.

Reading is the easiest way to filter the experience of others. The wise man reads to enrich his own experience, not merely to garner facts. By coming in close contact with the wide and varied life of others, he broadens his own vision and increases his own usefulness. Reading would be a waste of time if it were not for the fact that it gives, almost for the asking, experiences which other men have bought at great cost of time and energy.

Current technical literature records the latest experiences of men in specialized fields. For those in the same field of daily effort, such records save duplication of effort; those in other fields are prepared for the bigger and broader life to which their applied knowledge entitles them.

Engineering Honesty

Some doubt seems to exist regarding the statement in these columns last week that "engineering ethics are insistent that expert engineering opinion cannot be colored to favor the case of any client." The code of ethics adopted by the American Institute of Electrical Engineers in 1912, wherein it states:

The engineer should consider the protection of a client's or employer's interest his first professioinal obligation, and should therefore avoid every act contrary to this duty.

is quoted as authority to the contrary.

But such doubt is authoritatively removed by the first principle outlined in this code which insists that "In all his relations the engineer should be guided by the highest principles of honor." It is further stated that if any considerations interfere with his meeting the legitimate expectation of a client, the engineer should inform him of the situation.

As a witness, the engineer's attitude should be that of an impartial judge of the facts found in his investigation. The opposing lawyer naturally tries to place him in the false position of an advocate. Because of this predicament many engineers find difficulty in making their point clear to a judge, jury or commission. Their trouble usually comes either from a too technical treatment which the layman cannot

grasp or because their anxiety to simplify their testimony lays them open to the accusation of introducing extraneous matter to cloud the issue. Furthermore few engineers have sufficient knowledge of the law of evidence. If in doubt whether a question is admissible they should at least wait long enough to allow an objection to be interposed before answering.

An engineering witness should tell the truth, the whole truth, nothing but the truth. However he need not volunteer opinions that would be prejudicial to his employer's interest.

The Pacific Association of Consulting Engineers has been endeavoring to obviate some of these difficulties by having expert witnesses appointed by and compensated through the agency of the court.

While such a practice would be of material assistance, the engineer should always remember his early training with the instruments of precision, should make his statements absolutely square with the truth and never allow his actions to deviate from the hair-line of honesty.

Water Wheel Prayers

Of the several power-tinkering bills presented at the present Congressional session Bill No. 16,673 introduced in the House of Representatives on May 19, 1914, and favorably reported by Representative Graham from the Public Lands Committee on June 16, is reputed to be the "administration measure" and consequently has the greatest life expectancy. Like others of its kind, it is heralded as the panacea for all the ills with which hydroelectric power development is now afflicted and as the salvation for public ownership of public lands.

While Westerners do not deny that some relief is needed from the present throttling policy, careful investigation fails to reveal it in this measure.

In the main, this bill proposes to invest the Secretary of the Interior with discretionary power to lease water power sites in the public lands for periods of not more than fifty years. At the termination of the lease, either by expiration or for breach of terms, the property is either forfeited to the government upon payment of depreciated costs of construction or may be again leased to new parties paying such costs. The Secretary may give preference to state, county, and municipal systems, specify the rentals, and regulate the service, charges and securities of companies doing an interstate business.

Without discussing the grave question of the constitutionality of conferring such legislative powers upon the Secretary and without questioning the justice of a discriminatory excise tax on this industry or on these Western states, consider the real effect of these provisions in repelling capital, the factor upon which new development is primarily dependent.

Experience has demonstrated that a great hydroelectric system cannot be completely developed in much less than fifty years. Most of the great projects in the West are still in the period of new construction and extension after twenty-odd years of intensive development. A mush-room plant cannot serve the best interests of the people. A short-time bond on a property having no period of active earning is not readily saleable. Likewise in a bond market where municipal securities are competing for favor with public utility offerings, the discrimination which the Secretary may exercise in favor of municipal projects, particularly as regards rentals for property and rates to consumers, cannot but prejudice investors against private securities.

But the provision of most manifest unfairness is found in the payment to be made for the property in case it is taken over by the government. All those items, such as rights of way, water-rights, and land, which are subject to legitimate time appreciation in value are to be appraised at actual first cost, while those other items which are subject to depreciation are to be appraised at their depreciated value. Furthermore, no intangible value whatsoever is to be allowed. Naturally the thinking investor will wonder whether the meager returns from a property under development will compensate for the wear and tear on apparatus, the normal hazard of all business and the possibility of "fire, flood or other causes beyond human control."

Even those provisions of this bill which are not ambiguous in application, engender a feeling of doubt and uncertainty which is not conducive to confidence. But as all investment must be predicated upon confidence, money will seek channels of less resistance and development will stop because the wherewithal is lacking.

It is thus seen that this bill will defeat the very purpose for which it is alleged to have been drafted. And in stopping new development it prohibits competition and thus strengthens the position of those systems which were developed before these days when it is a crime to be successful.

While this journal has always been foremost in championing those factors which have developed the latent resources of the West, it has been equally insistant that a proper balance be maintained between public and private interests. The public has interests and rights which should be protected. But that public lives west of the Rocky Mountains in the states which have not wasted their patrimony and are not seeking to gain control of another's inheritance.

The West stands as a unit against those principles of this bill which provide absentee landlordism. Sectionalization, not centralization, is the need in this country which is already foremost in the regulation of public utilities. No bill should be passed which has not received endorsement of the people who will be most vitally affected by its enactment.

The proper authorities, the Secretary of the Interior for instance, should call a great meeting of Western representatives to consider this matter. Then, and then only, should a bill be passed by Congress. United action is now necessary. Every reader of this journal should write to his Congressman and urge that such action be taken and that no bills regarding the leasing of sites on non-navigable streams be passed at the present session.

Otherwise we may well follow the customs of far-away Bhutan, whose pious men pray with their water wheels by placing their written prayers in a cylinder revolved by a jet of water.

PERSONALS

F. H. Leggett, district manager of the Western Electric Company, was at Seattle, Wash., during the past week.

Hazard Stevens, president of the Olympia (Wash.) Light & Power Company, was a Seattle visitor during the past week.

J. Priestman, chief clerk, light and power department, B. C. Electric Company, is spending a vacation at Metchosin, B. C.

Rowe McCune of Toronto, Ont., has been appointed local manager at Vancouver, B. C., for the Otis-Fensom Elevator Company.

Jos. S. Thompson, president of the Pacific Electric Manufacturing Company, San Francisco, is making an extended business trip through California.

A. E. Morphy, assistant secretary of the Southern California Edison Company at Los Angeles, was at San Francisco during the past week.

E. M. Cutting, manager of the Edison Storage Battery Supply Company, San Francisco, recently returned from a several weeks' trip through the Northwest.

W. S. Berry, sales manager of the Western Electric Company, San Francisco, is making a short trip through the north of bay counties region of California.

J. H. Willard, of the Laco-Phillips Company, New York, is at Prince Rupert, B. C., from Vancouver, where he has an office as B. C. representative of the firm.

Thos. Finnigan, vice-president of Pierson, Roeding & Co., San Francisco, stole a march on his many bachelor friends this week and joined the ranks of benedicts.

F. J. Gibbons, sales manager for the Jefferson Glass Company Ltd., at Toronto, Canada, is at San Francisco in the course of a trip throughout the Pacific Coast.

H. G. Dran, plant inspector for the Western Electric Company, Hawthorne, Ill., arrived in San Francisco during the week on his inspection trip of the Coast houses.

D. E. Harris, of the Sales Department, Pacific States Electric Company, San Francisco, returned during the week from an extended trip through the north of bay counties region.

P. B. Hyde, representative of Thos. A. Edison Co., with offices in San Francisco, returned the first part of the week after a month's trip to Salt Lake City, various Montana and Idaho cities.

J. T. Stewart, salesman with the Pacific Coast office of the Holophane Works of the General Electric Company, left San Francisco this week to attend the summer sales conference at Cleveland, Ohio.

A. F. S. Steele, secretary Washington Water Power Company has returned to Spokane, Wash, from Houston, Tex., where he attended the International Convention of Rotary Clubs as the Spokane delegate.

L. A. Somers, in charge of the Industrial and Power Sales Department, Westinghouse Electric & Manufacturing Company, returned to San Francisco during the week, after an extended trip through Southern California.

John R. Brownell, formerly superintendent of the department of safety of the Pennsylvania Steel Company, has been recently appointed superintendent of safety for the Industrial Accident Commission of California.

W. H. Hanbridge, secretary of the California State Electrical Contractors' Association, was a visitor to Sacramento, Cal., during the week, where he completed details in connection with the coming annual state convention of his organization.

H. W. Beecher, Seattle manager; **James Burke**, Salt Lake manager; **W. H. Crawford**, Portland manager; **H. H. Clark**, Los Angeles manager, and **Geo. W. Hawkins**, Tucson manager for Chas. C. Moore & Co., are attending a company sales conference at San Francisco.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, has been appointed chairman of the General Convention Committee for the convention of the National Electric Light Association to be held at San Francisco in June, 1915.

F. W. Gitchell, who was formerly connected with the British Columbia Electric Railway Company, is at San Francisco en route to Winnemucca, Nev., to look after business matters in connection with the Charleston National Gold Mining Company in which he is interested.

Harry B. Dresser, correspondent for the Westinghouse Electric & Manufacturing Company for the past three or four years, at Salt Lake City, has been transferred to the district office of the Westinghouse Lamp Company, with offices in Salt Lake City as chief correspondent.

G. H. Morgan, telephone manager, Melbourne, Victoria, and **S. L. Monghan**, assistant telephone manager of Sydney, N. S. W., who were instructed by the postmaster-general of Australia to make a series of telephone investigations in America and Europe, recently spent a week in San Francisco en route to the East.

Lloyd Garrison, power engineer of the commercial department of the Utah Light & Railway Company, was married on Thursday, July 9th to Miss Josephine Evelyn Dresser of Salt Lake City. Mr. Garrison is a graduate of the University of Illinois, class of 1907, and has been in the employ of the Utah Light & Railway Company for the past five years.

Frank Seal has returned to Salt Lake City from Milwaukee where he has been studying for the past two years in the School of Engineering. Mr. Seal was formerly in the employ of the Capital Electric Company as construction foreman and later as traveling salesman. He has now taken a position as city salesman with the Inter-Mountain Electric Company.

Raymond E. Dresser, district superintendent for the Utah Power & Light Company, with headquarters at Montpelier, Idaho, is in Salt Lake City to attend the wedding of his sister Evelyn to Mr. Lloyd Garrison. Mr. Dresser will take a two weeks' vacation before returning to his duties. He reports much interest in southern Idaho in electric cooking. The demonstrations which his company has made during the past two or three months has stimulated a marked demand for electric ranges amongst the well-to-do farmers in his district. Crop conditions in that section of the counry were never more favorable and he is anticipating good business conditions will follow the harvesting of this season's bumper crops.

Frederick K. Lane, general manager and treasurer of the Seattle Lighting Company, was host at a luncheon served in the condenser and scrubber room of the works of the company at Seattle, Wash., to the members of the Publicity Industrial Bureau of the Seattle Chamber of Commerce. **John W. Lansley**, a Chicago newspaperman who has graduated into the gas industry, interestingly described to those present the various processes in gas manufacture. During his discourse he eulogized **S. R. Hutchinson**, assistant manager of the company; **N. C. Fancher**, superintendent, and **H. A. Miller**, engineer of the National Chamber Oven Company, who is at Seattle superintending the installation of ovens for the company.

M. C. Osborn, commercial agent Washington Water Power Company at Spokane, Wash., has just placed one two ton electric truck with the Beardmore Transfer Company, and a one ton truck with the Pacific Transfer Company. **Lewis A. Lewis**, assistant commercial agent, is stated to have said in connection with the sale of these trucks that a new plan is to be adopted by his company in charging for energy used. The cars have been sold without storage batteries

and for the use of these the company charges a rental depending upon the power used. In this way the rate is said to vary from 1¾ to 7 cents per car mile, depending upon the capacity of the car. Batteries are charged to run 45 miles and the cars are equipped with an indicator so that the driver may know the condition of the batteries. A run to the company's garage enables the dead batteries to be replaced with a recharged set. Considerable success is anticipated for this new system.

MEETING NOTICES.

California Association of Electrical Contractors' Convention.

The fifth annual convention of the California Association of Electrical Contractors and Dealers is to be held at Sacramento, August 4 to 8, 1914. An elaborate programme has been prepared, and papers by men prominent in the field of electrical endeavor are to be presented. The indications are for a record-breaking meeting, and the capital city is making extensive preparations for the entertainment of the delegates.

Telluride Association.

The annual convention of the Telluride Association, which has been in session at Provo, Utah, since June 22d, adjourned on July 6th to reconvene at Provo, Utah, on June 23, 1915. About fifty young men were granted scholarships at Cornell, Princeton, Purdue, Stanford, University of Missouri, and other universities. The following officers were elected for the ensuing year: President, L. G. Nightengale of New York; vice-president, David Wegg Jr., of Chicago; treasurer and Manager, W. L. Biersach of Provo; secretary, B. Landon Jr., of Chicago; dean, E. A. Thornhill of Boise, Idaho.

Utah Electric Show Association.

The Electric Show Association of Utah at a recent meeting of its board of directors decided to disband the association and distribute the capital funds and surplus now held in the treasury to the stockholders.

This association was incorporated three years ago for the purpose of giving an electric show in Salt Lake City. This show was held and was a highly successful one both from a result producing and a financial standpoint. The stock of the association was subscribed and taken by the various electrical interests represented in the state. A substantial dividend was paid after the first electric show and the surplus left in the treasury to be used in case subsequent shows were given. As a result of the impetus given the electrical appliance game by this show, the use of electrical appliances have become much more common than they were at that time and the directors have felt that the necessity of giving a show does not exist nearly to the extent now that it did then. In case it is decided later on to give an electric show it will not be a difficult matter to raise the necessary funds to do so. The central station companies, manufacturers, jobbers and supply dealers are now convinced of the opinion that one can be conducted on a profitable basis and it would not be a difficult matter to raise the necessary funds for this purpose in case it was decided to put on a show at some later date.

Pacific Claim Agents' Convention.

About forty members and guests attended the sixth annual convention of the Pacific Claim Agents' Association held at Spokane, Wash., on July 9, 10 and 11, 1914. Sessions were held in the Stone Room of the Hotel Spokane. An address of welcome was made by Wm. J. Hindley, mayor of the city, and other addresses were made by D. L. Huntington, president Washington Water Power Company, and by Waldo G. Paine, vice-president Spokane Inland Empire System. Papers were presented as follows: "What methods should be pursued in keeping informed of the movements of witnesses in cases where litigation is likely to arise," by A. M. Lee, assistant general claim agent, Northern Pacific Railway Company, Seattle, Wash. "What are the most effective methods that can be adopted by public service corporations in prosecuting fraudulent claimants and professional witnesses?" was presented by Harrison Allen, attorney Portland Railway, Light & Power Company, Portland, Ore., and by John S. Mills, assistant superintendent San Francisco-Oakland Terminal Railways, Oakland, Cal. "The prevention of automobile accidents" was discussed by S. A. Bishop, general claim agent, Pacific Electric Railway Company, Los Angeles, Cal., and by J. H. Handlon, United Railroads of San Francisco, Cal., president of the association. "Statistical information showing the accident cost of trainmen with respect to length of service," was presented by H. G. Winsor, claim agent Tacoma Railway & Power Company, Tacoma, Wash., and by Thomas G. Aston, claim agent Washington Water Power Company, Spokane, Wash. "To what extent can the claim department co-operate with the operating department in the matter of selecting trainmen as to their moral, mental and physical fitness?" was ably discussed by B. F. Boynton, claim agent Portland Railway, Light & Power Company, and by A. E. Beck, claims solicitor, B. C. Electric Railway Company, Ltd., Vancouver, B. C. A paper on remedying the trespassing evil was read by H. K. Rolf, general claim agent Spokane, Portland & Seattle Railway Company, Portland, Ore. Geo. Carson, general claim agent Puget Sound Traction, Light & Power Company, Seattle, Wash., and T. A. Cole, claim agent Los Angeles Railway Corporation, Los Angeles, Cal., read papers on the question, "Is it advisable for a statement to be secured from an injured person immediately after an accident occurs without regard to liability or the intention of the injured person to file claim?" In the absence of the author, a paper on "The evoltuion of 'Safety First'" by T. M. Lyall, assistant claim agent B. C. Electric Railway Company, was presented by one of the delegates. "What policy should be adopted in the disposition of claims of doubtful liability?" received attention at the hands of T. J. Rupli, assistant claim agent Puget Sound Traction, Light & Power Company, and Mrs. Ida P. Newell of the Portland Railway, Light & Power Company. The final session was devoted to a committee report on "Safety"—(A) from standpoint of (1) the public, (2) the companies; (B) Safety work of various companies, to general business, and the election and installation of officers. The association's new Safety Library was also exhibited at this session.

NEW CATALOGUES.

Duncan Electric Manufacturing Company has issued an attractive bulletin illustrating and describing its model M. I. Induction type Watthour Meter.

Holophane Works of General Electric Company are distributing their catalogue No. 311 on the Ivanhoe Counter Line of Metal Reflectors and Portable Fixtures. The revision of this line and the new schedule of discounts shows a careful study of interests of the trade.

The Wagner Electric Manufacturing Company, St. Louis, Mo., has just issued a bulletin on Central Station Lighting Transformers. The bulletin describes the distinguishing features which have characterized Wagner Transformers for many years, such as variable voltage taps, patented one piece porcelain outlet bushings, specially designed clamps for holding active material in the case, etc.

Simplex Steel Taped Cable is the title of a 16 page booklet which describes briefly the manufacture and uses of the cable which is protected by two steel tapes wound on spirally in reverse directions. The book illustrates and describes briefly, methods of installing steel taped cable in ornamental lighting systems, parks, the grounds of public buildings, and in railroad and manufacturing yards.

ELECTRICAL CONTRACTORS' DEPARTMENT

CO-OPERATION BETWEEN ELECTRICAL CONTRACTORS AND JOBBERS.

(This paper deals with the principles advocated by a joint committee of electrical jobbers and members of the California Association of Electrical Contractors and Dealers, giving an outline of the work which the committee propose to do.—The Editor.)

It is a recognized fact that certain branches of the electrical industry are today in a demoralized condition. As this is due largely to lack of proper co-operative effort on the part of the different branches of the industry it is the belief of the committee that, with a proper organization, whose primary interest is to educate its members to a greater responsibility, much good can be done in the way of properly serving the consumer and of creating a desire on his part to use electrical appliances and to adopt the idea, "Do it electrically," the slogan of "The Society for Electrical Development."

As examples of what can be accomplished, we only have to review the work of improvement clubs, societies, chambers of commerce and similar organizations throughout the country. Could individuals in the same period of time have brought about the reforms and changes in business methods that these associations have accomplished for their membership? The Panama-Pacific Exposition, about to be opened in San Francisco in 1915, is an evidence of co-operative association team work.

The Central Stations, through their strong organization, the National Electric Light Association, have brought the lighting and power industry to a high degree of development, and while doing so have reduced rates to the consumer—neither of which could possibly have been accomplished through individual effort.

Electrical Engineers, through the American Institute of Electrical Engineers, have been better prepared for their work through fuller knowledge of the requirements to be met and of the means of fulfilling them. This institute is conducted purely for educational purposes and without individual profit to its members, except in so far as they improve themselves by participating in the work.

Electrical Manufacturers and Jobbers through co-operative work have done much toward educating themselves, and as a result have placed their business on a firmer, more economical and more satisfactory basis. It has been proved through this work that, notwithstanding the increased cost of living and the consequent increase in the cost of almost every known commodity, the cost of electrical appliances has been steadily reduced and the quality of the article steadily improved. The principal effort on the part of these industries has been toward educating their members to the necessity of efficiency in order that the various branches may operate their particular businesses at a minimum of expense.

Architects have the American Institute of Architects as their national association. We would hardly recognize as progressive an architect who is not a member of this institute. Some of his most valuable information is obtained through such membership and through his affiliation with other architects in association work.

While undoubtedly electrical products have made more rapid strides in the last ten years than any other industry, the building industry generally has kept apace with the times. It is the belief of the committee, however, and it will be admitted by architects generally, that while satisfactory progress has been made in the building industry, at least from an architectural standpoint, the electrical equipment in buildings of all classes has been steadily neglected, and it is common practice today among many architects to use electrical specifications which have been regarded by the electrical industry for a long time past as absolete.

San Francisco today is an evidence of this. It has been almost entirely rebuilt within a period of seven years, and yet probably more than 95 per cent of the buildings erected in that period prove conclusively that the electrical specifications (and the ultimate installation) were neglected by architects generally. Of the remaining 5 per cent, probably not more than 25 per cent, or 1¼ per cent of the whole, have been equipped with modern electrical installations, and in making this estimate all classes of buildings have been taken into consideration.

Very recently certain firms of architects in San Francisco have engaged competent electrical engineers to prepare for them suitable specifications, but notwithstanding the engineer is handicapped in the preparation of specifications on account of the small proportion of the total cost of the building allowed him as his share. This condition is, of course, a direct reflection on the individual or firm of architects making the allowances.

The occupant of any commercial type of building, hotel, apartment house, flat, bungalow, or private home generally realizes only too late that no provision has been made for the many electrical conveniences. Many attempts have been made on the part of electrical people to assist architects in the drawing of proper specifications, but they invariably receive no encouragement, as certain architects really believe that they have forgotten more about proper electrical installations than all the electrical men in the country ever knew, and for this one reason they are impossible to approach.

They make no distinction between the reputable and the irresponsible electrical contractor. Their one idea seems to be to let the electrical contract simply on price. The result is evident:

Original cost of installation.....100 per cent
Extra before occupancy of building..... 25 per cent
Extra after building is complete..... 50 per cent

and the installation is still incomplete. An additional allowance, in the first place, would undoubtedly have provided a better installation wtih less cost to the owner.

Electrical contractors have their national and state associations, which have done much to educate their members in the proper conduct of their business, and through their local meetings and state conventions have made possible an exchange of ideas that has tended to elevate the standard of work.

Notwithstanding the great results that have been accomplished by the association, there are many electrical contractors who have failed to recognize the advantages to be gained by such association effort. This is evidenced by the present state of the electrical contracting business.

In the past, when a contractor has been approached and the suggestion offered that he become a member of the association, he has immediately asked, "What am I to gain by joining it?" The answer to this question is that he gets out in proportion to what he puts in. Having put in nothing in the past, nothing is what he has gotten out.

It is the belief of the committee that an electrical contractor unattached is unable to keep apace with the progress of the industry, and consequently is unable to properly serve his customers.

If he will become a member of the association and will give it his support, it would be impossible to estimate the benefits he will derive from it, as evidenced by the results of association work in other lines of endeavor, whether commercial or political.

As we have shown above that a competent architect should of necessity be a member of the American Institute

of Architects, or in some way affiliate with its local chapters, so it is clear that an electrical contractor should for the same reasons be a member of some association which represents his craft.

Distribution of Electrical Material.

It is fully recognized that the economic and proper channel of distribution of electrical supplies is through the electrical supply jobber to the dealer and contractor, who, in turn, serves the consumer. By this method of the dealer and contractor is enabled to have the advantage of a complete stock of electrical merchandise in the warehouse of the jobber, which can be drawn on at any time, no matter whether it is one item or a hundred, and can be assured of prompt shipments and satisfactory service from every standpoint.

The jobber makes it his business to keep in close personal contact with the dealer and contractor in his territory, studies his wants and plans to serve his needs, no matter what they may be. Through frequent calls of his salesman he is often enabled to give valuable information, keeping him advised of the new lines of standard goods on the market and furnishing technical data or give such other information as may be useful from time to time.

He is frequently able to be of service by carrying his contractor or dealer, who has been tied up financially on account of delays in jobs over which he has had no control.

This kind of service cannot be had where the contractors and dealers do business at long range and with people who are not in close touch or sympathy with their conditions or problems.

The dealer and contractor is the natural channel for distributing various electrical devices to the consuming public. He carries the material in stock and displays it on his counters and in his show windows. The consumer is thus enabled to see the material which he is purchasing, and knows that he is getting full value for his money. He can get promptly any information he needs or instructions in the use of the various electrical devices which is a service that could not be rendered satisfactorily by correspondence with some distant point.

Policy of Committee.

The object of this joint committee is to promote the use of electrical appliances and to influence the public to adopt the idea: "Do it electrically."

The co-operation of the central station in each district is highly desirable, and a closer relationship with the architect and those engaged in the industry must be maintained. In the past the industry has failed to provide suitable show rooms at which the consumer can obtain electrical appliances, therefore we will encourage the establishing of proper stores where material can be obtained at retail.

To accomplish this end a campaign of education is about to be instituted. It provides for visits by the committee to all parts of the state, where public lectures will be given, supplemented by moving pictures, stereopticon views and working demonstrations of electrical appliances.

In order to gain the full confidence of the public in the industry we represent, the class of material furnished and the excellence of workmanship in its installation must be of the highest order. We should never recommend for sale an article in which we have not absolute confidence and a full knowledge of the functions it will be called upon to perform.

We should not consider an installation as tending to promote the best interests of the industry unless it has met with the unqualified conviction on the part of the contractor that it is of the highest class. An installation made by an electrical contractor, simply because it will pass inspection, is undoubtedly bad practice.

We recognize that, in our business probably more than in any other, the public is woefully ignorant of the quality and merits of electrical devices. Whether or not they are satisfied depends upon how we serve them. We should recognize that the National Electric Code, while having accomplished a great good, does not to the fullest extent accomplish the desired results, for the reason that it does not distinguish between standards of material.

We will advocate the grading of material by the National Fire Protection Association.

We recognize that local inspection bureaus are not responsible for installations in compliance with architects' specifications.

We will advocate the employment of one or more competent electrical engineers, whose duty it will be to furnish architects with certificates, certifying that work has been performed in accordance with the specifications embodied in the contract.

Work may be performed which in every respect meets the requirements not only of the National Fire Protection, but local, state or municipal inspection bureaus, which is not a credit to the electrical industry. We are opposed to electrical contractors who, after executing a contract, endeavor to substitute material of a lower grade. We advocate that the various electrical contractors' associations should assume the responsibility for seeing that their members perform work in accordance with specifications without attempting to evade their contract in any detail.

We believe that with proper co-operation on the part of the architect and other allied interests, the various state associations of electrical contractors will ultimately be able to guarantee on behalf of their members the completion of any contract entered into.

We will ascertain the names of all societies of architects, times and places of meeting, and will endeavor to have representative electical engineers, as well as members of our joint committee, appear before these associations to explain the necessity of not only the proper drawing of, but also the compliance with recognized modern specifications.

Caution should constantly be exercised to see that only those contractors are admitted to membership of an association whose character and honesty are unquestioned and who have an established reputation for square dealing.

ELECTRICAL CONTRACTORS' NOTES.

Smith & McCoy have the electrical contract on the apartment house being erected on the corner of Twenty-first & Glisen streets, Portland, Oregon.

The General Electric Company has obtained the contract for 1-200 h.p. and 1-150 h.p., 3-phase, 60-cycle, 440-volt induction motors to be used in connection with the new ice hippodrome in Portland, Oregon.

The Central Electric Company, San Francisco, is putting in the electrical equipment for the Union Pacific's Yellowstone Park Exhibit at the Panama-Pacific International Exposition. The contract price is $6583.

The Morrison Electric Company has obtained the contract to furnish and install the electrical fixtures in the new 12 story office building of the Pacific Telephone & Telegraph Company, which has been recently erected in Portland, Oregon.

The W. W. Smith, Electrical Engineering Company, Spaulding Building, Portland, Oregon, has obtained the electrical contract for the wiring of the new Burnside Theatre, being erected by A. C. Ruby on Fifth and Burnside streets, Portland, Oregon.

The Inter-Mountain Electric Company of Salt Lake City is just starting construction work on the electrical wiring and equipment of the new bank building and hotel being erected in Logan, Utah, by the Thatcher Bros. Banking Company, replacing the former bank building which burned down a year ago.

Ne Page, McKenny & Company have obtained the contract to complete the electrical installation in the Homeopathic Hospital, located at E. Twenty-second and Multnomah streets, Portland, Oregon. This building has been in course of construction for the past three years. Funds are now available for completion of the structure.

The Pacific Fire Extinguisher Company, San Francisco, is installing the general and decorative lighting wire for eight buildings at the Panama-Pacific International Exposition. These include the Food Products, Education, Agricultural, Liberal Arts, Transportation, Manufactures, Mines, and Varied Industries Buildings. The contract price is $13,650.

NEWS OF THE CALIFORNIA RAILROAD COMMISSION.

The commission has rendered a decision dismissing the application of the Indian Valley Electric Light & Power Company for a modification of the commission's order of September 21, 1912, authorizing the issue of $81,535 bonds. The power company desired this modification in order that it might lease the reservoir site of the Round Valley Water Company at Greenville, Plumas county, and use the water therein to operate a new hydroelectric plant. At the hearing it developed that the right to the water was in litigation and the commission held that it could not authorize an issue of bonds based on a lawsuit where a substantial issue is involved in the suit. The application was therefore dismissed without prejudice to a renewal or presentation of a different plan by the stockholders of the Indian Valley Electric Light & Power Company.

The commission has rendered a decision dismissing the application of the Oro Electric Corporation and the Oro Development Company for permission to sell 1000 first mortgage 6 per cent sinking fund gold bonds, and to confirm the sale of 686 bonds of the Oro Electric Corporation. This action was taken upon the request of the companies involved.

The commission has rendered a decision in the complaint brought by the city of Los Angeles against the Southern California Gas Company, the Los Algeles Gas & Electric Corporation, the Southern California Edison Company and the Economic Gas Company. The city sought to compel the gas companies to resume the supply of natural gas to the citizens of Los Angeles. Since February 20, 1914, there has been practically no natural gas sold or used in Los Angeles, except by the Los Angeles Gas & Electric Corporation and the Southern California Gas Company in their own plants, although at the hearing it developed that a large supply was available. The jurisdiction of the commission in this case was in doubt. The commission finally decided that it had no jurisdiction to compel any of the companies to deliver natural gas in Los Angeles and insofar as the complaint asked for relief in this particular, it must be dismissed. The commission held, however, that it had power to order the Southern California Gas Company to resume the delivery of natural gas to the Los Angeles Gas & Electric Corporation and the Economic Gas Company at the West Glendale terminus of the Midway Pipe Line and made its order accordingly.

The commission has rendered a decision in the complaint filed by the town of Antioch, Contra Costa county, against the Pacific Gas & Electric Company. The complaint charged that the company's rates for electricity for general domestic and commercial use and street lighting were unreasonable.

In arriving at its decision, the commission made an investigation of the company's entire hydroelectric system, extending from the crest of the Sierras to the Pacific Ocean, and its steam plants as well as its local distributing system at Antioch. The Pacific Gas & Electric Company held that it should be allowed a return on the basis of the cost to reproduce its plant new plus an allowance for going concern value. In figuring the basis of return, the commission cut the overhead percentages to be added for administration, taxes, insurance, etc., from about 25 per cent, as estimated by the company's engineers, to about 12 per cent. The decision then proceeds to fix an average cost for electric energy deliverable at substations. At the hearing of the case, it was agreed by the Pacific Gas & Electric Company that the basis fixed in this decision might be used as the basis upon which to ascertain the cost of energy delivered to any of the cities which it serves, and in fixing rates hereafter, it will only be necessary for the commission to determine the cost of distribution in any locality. This average cost as found by the commission is .007312 per kw-hr.

The Holton Power Company, of Redlands, has filed an application with the Railroad Commission asking authority to issue $200,000 par value first and refunding mortgage gold bonds.

The commission has rendered a decision authorizing the Round Valley Water Company, of Greenville, Plumas County, to lease its property to the Plumas Light and Power Company, formerly known as the Indian Valley Electric Light and Power Company. The commission also authorized the power company to lease a portion of its property to Clara Bidwell. These two leases are part of a transaction by which the water stored in the Round Valley Water Company's reservoir is to be used for developing hydroelectic power.

The commission has made a supplemental order authorizing the Fresno Interurban Railway Company to issue 600 shares of stock and $120,000 of bonds. The authority is conditioned upon the railway company securing a franchise through the town of Clovis, Fresno County, before July 20, 1914 .

The Southwestern Home Telephone Company of Redlands, San Bernardino County, has filed an application with the commission asking authority to execute its promissory note in the amount of $4500, with interest at a rate not to exceed 8 per cent per annum.

The Pacific Light and Power Corporation of Los Angeles has filed an application with the commission asking authority for an issue of stock and bonds. The proceeds are to be used for refunding floating indebtedness incurred on account of betterments, additions and improvements.

RULING SAN FRANCISCO DEPARTMENT OF ELECTRICITY.

In all disputes arising over the classification of any building, in so far as this classification determines the class of electrical construction which shall be used in wiring same, the department of electricity will accept the classification on the building permit as applying to Section "M" of Ordinance No. 2582. This shall not be construed to include flats with stores underneath, which shall be "all conduit" jobs. This ruling becomes effective at once.

TRADE NOTES.

The strike of the employes of the Westinghouse companies at Pittsburg was ended during the past week when all employes returned to work under the former schedule of time and wages. The Westinghouse Electric & Manufacturing Company and the Westinghouse Machine Company are again in a position to fill all orders.

The Standard Electric Time System is to be installed at the Western Residential Schools on Shaughnessy Heights, Vancouver, B. C., by Messrs. Chapman & Walker. The contractors are Hicks & Scattergood; Herbert Moss of Seattle, Wash., is consulting engineer, and McClure & Fox, Vancouver, B. C., architects.

The plant of the Salmon River Lumber Company about one mile from Sperling Station, on the Fraser Valley & Southern Railway, was destroyed by fire last week. The loss is estimated at $40,000 and is said to have been mostly covered by insurance. It is the intention of the owners to at once commence rebuilding the mill which will be up-to-date in all respects.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—Hoagland-Lakin Electric & Engineering Company has been incorporated with a capital stock of $25,000. A. L. Lakin, H. A. Hoagland, M. W. Hulse, D. Schoonmaker, R. E. Amann are the directors.

RIVERSIDE, CAL.—The Twin Springs Water Company, principal place of business at Riverside, has filed articles of incorporation, with a capital stock of $4000. The company plans to put water on Alamo tract. The directors are S. C. Evans, M. L. Evans, E. S. Evans, P. T. and C. Evans.

THOMPSON FALLS, MONT.—The Interstate Power Company has filed articles of incorporation to transact a mercantile, industrial, manufacturing and mechanical business, and create or obtain electrical power. Thompson Falls is the principal place of business. Edward Donlan, I. E. Keith and Andrew Peterson, are the incorporators.

CARSON CITY, NEV.—The Canyon Power Company, a California corporation, has filed articles of incorporation with the Secretary of State. The company has an authorized capital of $1,000,000, divided into 10,000 shares of a par value of $100. Leon M. Grove, H. L. Breed, Chas. Gross, J. E. Bowes and E. A. Herrmann of Oakland appear as the original incorporators and stockholders.

ILLUMINATION.

ST. HELENA, CAL.—Fifty-three 3-light electroliers were recently installed along Main street by the Napa Valley Electric Company.

DUNCAN, ARIZ.—J. B. Spaw has sold the local light plant to J. Allen, who, it is understood, plans to enlarge the plant in the near future.

PASADENA, CAL.—The city commissioners are contemplating the erection of an addition and improvements to the municipal lighting plant to cost $20,000.

SANTA CRUZ, CAL.—The Coast Counties Gas & Electric Company has filed suit against the stockholders of the Santa Cruz Beach Company to recover $41,429 for light and power.

DAWSON, Y. T.—The electors of the city of Dawson have voted in favor of selling bonds to the extent of $200,000 for the installation and operation of a government owned light and power plant.

BAKERSFIELD, CAL.—C. H. L. Griest and C. H. L. Griest Jr. have applied for a franchise for 50 years, to maintain an electric pole, tower and wire system. Sealed bids will be received for such a franchise up to August 8th.

SEATTLE, WASH.—Bids will be received by the Board of Public Works up to July 24th for furnishing the city of Seattle lighting department during the year 415,500 incandescent lamps. A certified check in the sum of $3000 payable to the city comptroller is required with each bid.

LOS ANGELES, CAL.—The Board of Works has signed a contract with the Los Angeles Gas & Electric Company to supply current to 500 new arc lights for 18 months at $6.30 a month each and with the Pacific Light & Power Company to furnish current for incandescent lamps in the Hollywood District at $1.50 each.

PORTLAND, ORE.—Announcement was made at a recent meeting of the Manufacturers' Association that the Electrolytic Gas Company of Dayton, Ohio, has determined to locate in Portland. E. F. Platt, president of the company, recently visited Portland to investigate the field with the view of establishing a plant.

SPOKANE, WASH.—C. M. Fassett, commissioner of public utilities has recommended that the city adopt nitrogen filled Mazda lamps for street lighting purposes and in substantiation of recommendations quoted the saving thus effected by other cities. Mr. Fassett is reported to have made at that time, the erroneous statement that the new half-watt lamp is also available for domestic lighting purposes.

DRAIN, ORE.—The City Council has decided to sell $6000 worth of city bonds to raise money to install an electric lighting system for the city of Drain. As soon as the bonds are sold the council will enter into a contract with the Douglas County Light & Water Company, of Roseburg. The company says it can complete the line from Winchester by November 1st, which will insure electric lights for Drain by that time.

SAN FRANCISCO, CAL.—Action was begun in the United States District Court Friday by the Pacific Gas & Electric Company to restrain the city from enforcing the 75c gas rate recently fixed by the supervisors. The gas company claims that at the proposed rate the receipts for the year to end June 30, 1915, will not exceed $3,499,849. The expense of operating is placed at $2,280,221 and the company claims that $650,598 will be written off for deprecation. The net would thus amount to $569,220, which, it is claimed, would give only 3¼ per cent to the stockholders.

TRANSMISSION.

SOUTH BEND, WASH.—The Willapa Electric Company has been granted the right to construct lines of transmission, distribution and utilization of electrical energy along Quincy street.

SALEM, ORE.—State Engineer Lewis has approved of the application of Geo. W. Holcomb, Portland, to appropriate 1500 second ft. of waters of Clackamas River for the development of 10,225 h.p. The estimated cost is $1,000,000. An 80 ft. dam is proposed.

PORTLAND, ORE.—The state engineer has granted a permit to the Portland Railway, Light & Power Company to construct reservoirs on the headwaters of Clackamas River. The smaller to require a 30 ft. high dam for the storage of 17,900 acre ft., and the larger one to require a 80 ft. dam for 40,400 acre ft.

REDDING, CAL.—A tunnel a mile long has been dug in the Big Bend of the Pitt River as a starter to a power development project undertaken over a year ago by the Mount Shasta Power Corporation. The tunnel will be almost seven miles long. It is to convey water from Pitt River through a mountain divide to a point where a tremendous fall will be available for power generating purposes. The tunnel so far dug is seven feet wide and nine feet high. Later it will be enlarged to a width of 16 feet and a height of 19 feet. Crews are working at both ends.

FALLON, NEV.—When bids for the lease of the power from the Lahontan plant were opened at Reclamation headquarters last week, there was but one bid, that of the Canyon Power Company of Oakland, Cal. The present bid is for one-fourth of one cent, or $.0025 per kw.-hr. for the gross output of the plant during the summer months, and $.0037½ per kw.-hr. during winter months. This will make the minimum $1200 per month for the months of April, May, June, July, August and September. The minimum annual income will be about $14,000 and the maximum $30,000, and the probable average about $20,000 annually. If this contract is not made, it is a well-known fact that the Lahontan plant will be operated at a heavy loss after the next few months when the construction work at the dam will be completed. Under the proposed contract this prospective loss will be changed to a net profit in the above amounts.

TRANSPORTATION.

STOCKTON, CAL.—Bids will be received until July 20th for a 50 year franchise applied for by the Stockton Electric Railroad Company.

VANCOUVER, B. C.—It is authoritatively stated that the advance railway bookings to the Panama-Pacific International Exposition via this city already aggregate 4000 per day.

BILLINGS, MONT.—It is reported that officials of the Chicago, Burlington & Quincy Railroad are seriously considering the electrification of 500 miles of road adjacent to Billings.

SAN FRANCISCO, CAL.—The Board of Public Works received 11 bids for grading the site of the new car barn on Seventeenth street for the Municipal Railway, the lowest being that of the Daniel O'Day Company for $34,850.

SEATTLE, WASH.—An ordinance has been introduced adopting a plan for making extensions to the street railway system by the construction of tracks over Fourth avenue, et al. The bill has been referred to the city utilities committee.

HEALDSBURG, CAL.—Alfred D. Bowen, who promoted the Petaluma & Santa Rosa Railroad, has applied to the city trustees of Healdsburg for a franchise for twelve miles of electric railroad out from Healdsburg through the Dry creek valley.

SACRAMENTO, CAL.—General Manager McGovern, of the Northern Electric Railway Company, announces that $50,000 will be spent this summer in re-ballasting its roadbed, replacing wooden culverts with concrete. A fast through train service between Chico and San Francisco is to be inaugurated.

OGDEN, UTAH.—The Salt Lake & Ogden Railway Company has received eight large electric interurban cars belonging to the Orem road, the cars to be assembled and tested out by the Bamberger company before they are placed in service on the southern Utah line. The cars are of the latest type and equal in size to those of the Bamberger line.

SPOKANE, WASH.—The city has passed and the Washington Water Power Company has accepted a franchise for the Boone avenue extension and for Trent avenue, west of Division street. It is stated that the Washington Water Power & Inland Empire Companies have reached an agreement whereby the Water Power Company can commence work on its Boone avenue, extension without delay.

SAN FRANCISCO, CAL.—Action was taken last week by the supervisors looking to the extension of the municipal street car system through Golden Gate Park from Tenth avenue in the Richmond to the south site of the park, and the Potrero avenue line into the Scotch Hill section. Supervisor Vogelsang introduced a resolution, which was passed, requesting the city engineer to prepare plans to estimate the cost of this work.

SACRAMENTO, CAL.—An injunction permanently restraining the Pacific Gas & Electric Company from constructing double tracks across Tenth and K streets was granted to the city in an opinion handed down by Superior Judge N. D. Arnot of El Dorado as presiding judge of department 3 of the Sacramento Superior Court. This opinion terminated a contest between the city and the street car company, which was commenced in October of 1912 and which involved the rights of the car company under the charter and franchises. The principal point involved in the suit was the placing of tracks across K street. The city held it was a new piece of work; the company held it was the mere physical connection between two franchises already obtained by the company made necessary by the demand for better service.

SAN FRANCISCO, CAL.—The first shipment of four cars for the Municipal Railway has been made by the Jewett Car Company of Newark, O., and more will be sent this month. The contract calls for the delivery of 25 cars every month, beginning August 14th. A bonus of $5 a day on each car is allowed for early shipment each month. In all, 125 cars have been ordered. It is expected that the operation of the Van Ness avenue and Chestnut street line will be begun August 15th with the first 25 cars, the construction of this line being ahead of schedule time, which fixed its completion and operation for September 1st. Assistant Engineer Ransom says that the Potrero avenue and Eleventh street line will be ready probably on September 1st, a month ahead of the time set.

RED BLUFF, CAL.—Suit has been filed by H. C. Hendricks against the Sacramento Valley Electric Railway Company to cancel a note for $1500 for the purchase of stock in the company. This suit was brought as a test case. Its decision may affect holdings to the extent of $100,000. Hendricks claims that the note was given for stock purchased on the understanding that work on the road would not be commenced until sufficient money was in the company's treasury to build the line from start to finish. The company having let a contract for a 12½ mile unit, from Dixon south, at a time when the funds in the treasury are not sufficient to allow of further construction work being done, Hendricks claims this in violation of the understanding. An injunction is now in progress in the Superior Court of San Francisco, against the railroad to restrain it from building the Dixon unit. This action was brought by Z. P. Dyer.

OGDEN, UTAH.—The Ogden Rapid Transit Company has awarded the contract for the line material and electrical equipment necessary for the electrification of the extension of its interurban line north from Brigham City to Preston, Idaho. The electrical equipment of the substation and the cars was awarded to the Westinghouse Electric & Manufacturing Company with district offices in Salt Lake City. Fifteen hundred volts direct current equipment will be used. The contract for the line material was awarded to the Ohio Brass Company, represented in Salt Lake City by Mr. Frank B. Cook. This 96 mile extension of the Ogden Rapid Transit Company north from Ogden to Preston, Idaho, will connect at Ogden with the Salt Lake & Ogden Railway Company, better known as the Bamberger line which has been operating by electricity between Salt Lake City and Ogden, a distance of 36 miles during the past three years. At Salt Lake City the Salt Lake & Ogden Railroad connects through a Union Depot with the Orem line, running south of Salt Lake City to Provo, a distance of 50 miles. The Orem line is now being equipped with Westinghouse electrical equipment using 1500 volt direct current also. The Orem line will next year extend its terminus from Provo south to Payson, a distance of 20 miles further, so that when this system is completed and in operation the state of Utah will be traversed from north to south, a distance of over 200 miles, with hiigh speed interurban electric lines.

TELEPHONE AND TELEGRAPH.

OLYMPIA, WASH.—The State Minimum Wage Commission has adopted the recent conference recommendation of $9 a week as the minimum for telephone girls throughout the state.

BOLINAS, CAL.—Contractors have completed construction of the Marconi wireless telegraph station, a short distance from town. This is the sending station for the Marin county unit of the system, the receiving station being located at Marshall's, sixteen miles away. Included in the equipment of the local station is a 500 h.p. motor. Messages will be sent and received largely between this point and the Honolulu station, which has also been completed. The two plants of the system represent an investment of upward of $500,000. They are being tested out prior to going into regular service some time about July 20th. The Marin county station is a unit in the system, which will comprise eleven stations, located at various intervals over the circumference of the globe.